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Federal Register

Part II

Environmental Protection Agency

40 CFR Parts 141, 142, and 143
National Primary Drinking Water
Regulations; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 141, 142, and 143

[WH-FRL-3380-1]

National Primary Drinking Water Regulations—Synthetic Organic Chemicals and Inorganic Chemicals; Monitoring for Unregulated Contaminants; National Primary Drinking Water Regulations Implementation; National Secondary Drinking Water Regulations

AGENCY: U.S. Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: By this document, EPA is promulgating maximum contaminant level goals (MCLGs) and National Primary Drinking Water Regulations (NPDWRs) for 28 synthetic organic chemicals (SOCs) and 7 inorganic chemicals (IOCs). (The MCLGs and MCLs for aldicarb, aldicarb sulfoxide, aldicarb sulfone, pentachlorophenol and barium are repropounded elsewhere in today's *Federal Register* due to changes in the health basis for the MCLGs and/or revised MCLs.) The NPDWRs consist of maximum contaminant levels (MCLs) or treatment techniques for the SOCs and IOCs. The NPDWRs also include monitoring, reporting, and public notification requirements for these compounds. This document includes the best available technology (BAT) upon which the MCLs are based and the BAT for the purpose of issuing variances. The Agency is promulgating secondary MCLs (SMCLs) for two contaminants and one-time monitoring requirements for approximately 30 SOCs and IOCs that are not regulated by NPDWRs.

EFFECTIVE DATE: All sections (141.11, 141.23, 141.24, 141.32, 141.40, 141.50, 141.60, 141.61, 141.62, 141.110, 141.111, 142.14, 142.15, 142.16, 142.57, 142.62, 142.64, 143.3, and 143.4) of this regulation are effective July 30, 1992. The information collection requirements of §§ 141.23, 141.24 and 141.40 are effective July 30, 1992 if the Information Collection Request is cleared by the Office of Management and Budget (OMB). If not, the requirements will be effective when OMB clears the request at which time a document will be published in the *Federal Register* establishing the effective date. In accordance with 40 CFR 23.7, this regulation shall be considered final Agency action for the purposes of judicial review at 1 p.m., Eastern time on February 13, 1991.

ADDRESSES: A copy of the public comments received, EPA responses, and all other supporting documents (including references included in this notice) are available for review at the U.S. Environmental Protection Agency (EPA), Drinking Water Docket, 401 M Street, SW., Washington, DC 20460. For access to the docket materials, call 202-382-3027 between 9 a.m. and 3:30 p.m. Any document referenced by an MRID number is available by contacting Susan Laurence, Freedom of Information Office, Office of Pesticide Programs, at 703-557-4454.

Copies of health criteria, analytical methods, and regulatory impact analysis documents are available for a fee from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. The toll-free number is 800-336-4799, local: 703-487-4850.

FOR FURTHER INFORMATION CONTACT: Al Havinga, Criteria and Standards Division, Office of Drinking Water (WH-550), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460, 202-382-5555, or one of the EPA Regional Office contacts listed below. General information may also be obtained from the EPA Drinking Water Hotline. The toll-free number is 800-426-4791, local: 202-382-5533.

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Abbreviations Used in This Document

AA: Direct Aspiration Atomic Absorption Spectroscopy
ADI: Adjusted Daily Intake
BAT: Best Available Technology
BTGA: Best Technology Generally Available
CAA: Clean Air Act
CAG: Cancer Assessment Group
CRAVE: Cancer Risk Assessment Verification Endeavor

CUR: Carbon Usage Rate
CWS: Community Water System
DWEL: Drinking Water Equivalent Level
EBCT: Empty Bed Contact Time
ED: Electrodialysis
EDR: Electrodialysis Reversal
EMSL: EPA Environmental Monitoring and Support Laboratory (Cincinnati)
FmHA: Farmer's Home Administration
GAC: Granular Activated Carbon
GFAA: Graphite Furnace Atomic Absorption Spectroscopy
ICP-AES: Inductively Coupled Plasma-Atomic Emission Spectroscopy
IE: Ion Exchange
IMDL: Inter-Laboratory Method Detection Limit
IOC: Inorganic Chemical
LOAEL: Lowest-Observed-Adverse-Effect Level
LOQ: Limit of Quantitation
MBS: Multinational Business Services, Inc.
MCL: Maximum Contaminant Level (expressed as mg/l)¹
MCLG: Maximum Contaminant Level Goal
MDL: Method Detection Limit
MCD: Million Gallons per Day
NAS: National Academy of Science
NPDWR: National Interim Primary Drinking Water Regulation
NIST: National Institute of Standards and Technology
NOAEL: No-Observed-Adverse-Effect Level
NORS: National Organic Reconnaissance Survey
NPDWR: National Primary Drinking Water Regulation
NSF: National Sanitation Foundation
NTWS: Non-Transient Non-Community Water System
OPP: EPA's Office of Pesticide Programs
PAP: Polymer Addition Processes
PE: Performance Evaluation
POE: Point-of-Entry Technologies
POU: Point-of-Use Technologies
PQL: Practical Quantitation Level
PTA: Packed Tower Aeration
PWS: Public Water System
RfD: Reference Dose (formerly termed Acceptable Daily Intake (ADI))
RIA: Regulatory Impact Analysis
RMCL: Recommended Maximum Contaminant Level
RO: Reverse Osmosis
RSC: Relative Source Contribution
SDWA: Safe Drinking Water Act, or the "Act," as amended in 1986
SMCL: Secondary Maximum Contaminant Level
SOC: Synthetic Organic Chemical
TEM: Transmission Electron Microscopy
THMs: Trihalomethanes
TON: Total Odor Number
TWS: Transient Non-Community Water System
UF: Uncertainty Factor
UIC: Underground Injection Control
VOC: Volatile Organic Chemical
WHP: Wellhead Protection

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¹ 1,000 micrograms (µg) = 1 milligram (mg).

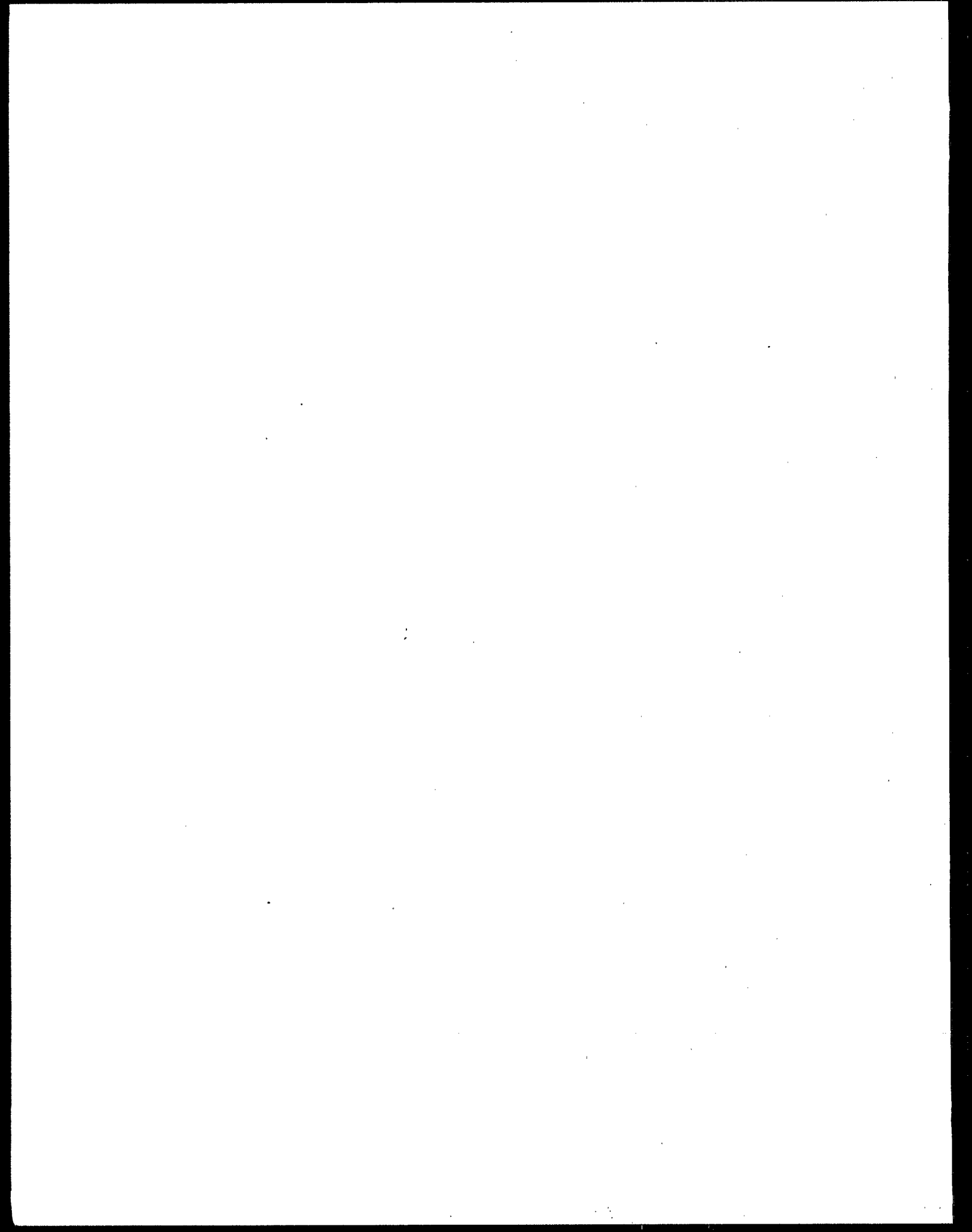


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I. Summary of Today's Action
The effective date of this rule is July 30, 1992.

TABLE 1.—MCLGS AND MCLS FOR INORGANIC CONTAMINANTS

	MCLGs	MCLS
(1) Asbestos	7 million fibers/liter (longer than 10 μ m)	7 million fibers/liter (longer than 10 μ m).
(2) Cadmium	0.005 mg/l	0.005 mg/l.
(3) Chromium	0.1 mg/l	0.1 mg/l.
(4) Mercury	0.002 mg/l	0.002 mg/l
(5) Nitrate	10 mg/l (as N)	10 mg/l (as N).
(6) Nitrite	1 mg/l (as N)	1 mg/l (as N).
(7) Total Nitrate and Nitrite	10 mg/l (as N)	10 mg/l (as N).
(8) Selenium	0.05 mg/l	0.05 mg/l.

TABLE 2.—MCLGS AND MCLS FOR VOLATILE ORGANIC CONTAMINANTS

	MCLGs (mg/l)	MCLS (mg/l)
(1) o-Dichlorobenzene	0.6	0.6
(2) cis-1,2-Dichloroethylene	0.07	0.07
(3) trans-1,2-Dichloroethylene	0.1	0.1
(4) 1,2-Dichloropropane	0	0.005
(5) Ethylbenzene	0.7	0.7
(6) Monochlorobenzene	0.1	0.1
(7) Styrene	0.1	0.1
(8) Tetrachloroethylene	0	0.005
(9) Toluene	1	1
(10) Xylenes (total)	10	10

TABLE 3.—MCLGS AND MCLS FOR PESTICIDES/PCBS

	MCLGs	MCLS (mg/l)
(1) Alachlor	Zero	0.002.
(2) Atrazine	0.003 mg/l	0.003.
(3) Carbofuran	0.04 mg/l	0.04.
(4) Chlordane	Zero	0.002.
(5) 1,2-Dibromo-3-chloropropane (DBCP)	Zero	0.0002.
(6) 2,4-D	0.07 mg/l	0.07/l.
(7) Ethylene dibromide (EDB)	Zero	0.00005.
(8) Heptachlor	Zero	0.0004.
(9) Heptachlor epoxide	Zero	0.0002.
(10) Lindane	0.0002 mg/l	0.0002.
(11) Methoxychlor	0.04 mg/l	0.04.
(12) Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl)	Zero	0.0005.
(13) Toxaphene	Zero	0.003.
(14) 2,4,5-TP (Silvex)	0.05 mg/l	0.05.

TABLE 4.—MCLGS AND TREATMENT TECHNIQUE REQUIREMENTS FOR OTHER ORGANIC CONTAMINANTS

	MCLGs	MCLS
(1) Acrylamide	Zero	Treatment technique.
(2) Epichlorohydrin	Zero	Treatment technique.

TABLE 5.—SECONDARY MAXIMUM CONTAMINANT LEVELS (SMCLS)

(1) Aluminum	0.05 to 0.2 mg/l.
(2) Silver	0.1 mg/l.

TABLE 6.—BEST AVAILABLE TECHNOLOGIES TO REMOVE INORGANIC CONTAMINANTS

Inorganic contaminant	Best available technologies									
	Activated alumina	Coagulation/filtration ¹	Corrosion control	Direct filtration	Diatomite filtration	Granular activated carbon	Ion exchange	Lime softening ²	Reverse osmosis	Electrolysis
Asbestos		X	X	X	X		X	X	X	X
Barium							X	X	X	
Cadmium		X					X	X	X	
Chromium		X					X	X	X	
Chromium VI		X					X	X	X	
Mercury		X				X	X	X	X	X
Nitrate							X	X	X	
Nitrite							X	X	X	
Selenium	X	X						X	X	X
Selenium VI							X	X	X	
Selenate							X	X	X	

BAT only if influent mercury concentrations do not exceed 10 μ g/l. Coagulation/filtration for mercury removal includes PAC addition or post-filtration GAC (GAC only where high organic mercury is present in source water).

² Not BAT for small systems for variances unless treatment is currently in place.

TABLE 7.—BEST AVAILABLE TECHNOLOGIES TO REMOVE SYNTHETIC ORGANIC CONTAMINANTS

Chemical	GAC ¹	PTA ²	PAP ³
VOCs:			
o-Dichlorobenzene	X	X	
cis-1,2-Dichloroethylene	X	X	
trans-1,2-Dichloroethylene	X	X	
1,2-Dichloropropane	X	X	
Ethylbenzene	X	X	
Monochlorobenzene	X	X	
Styrene	X	X	
Tetrachloroethylene	X	X	
Toluene	X	X	
Xylenes (Total)	X	X	
Pesticides/PCBs:			
Aldicarb	X		
Aldicarb sulfone	X		
Aldicarb sulfoxide	X		
Atrazine	X		
Carbofuran	X		
Chlordane	X		
2,4-D	X		
Dibromochloropropane (DBCP)	X	X	
Ethylene Dibromide (EDB)	X	X	
Heptachlor	X		
Heptachlor epoxide	X		
Lindane	X		
Methoxychlor	X		
PCBs	X		
Pentachlorophenol	X		
2,4,5-TP (Silvex)	X		
Toxaphene	X		
Other Organic Contaminants:			
Acrylamide			X
Epichlorohydrin			X

¹ GAC = Granular activated carbon.² PTA = Packed tower aeration.³ PAP = Polymer addition practices.

TABLE 8.—COMPLIANCE MONITORING REQUIREMENTS

Contaminant	Base requirement		Trigger that increases monitoring	Waivers
	Ground water	Surface water		
	1 sample/3 yr	Annual sample		
5 Inorganics	1 sample/9 years after 3 samples < MCL		> MCL	Yes: Based on analytical results of 3 rounds.
Asbestos	1 sample every 9 years		> MCL	Yes: Based on vulnerability assessment.
	Annual	Quarterly		
Nitrate	After 1 year < 50% MCL SWS, may reduce to an annual sample.		> 50% MCL	No.
Nitrite	1 Sample—If < 50% of MCL, state discretion.		> 50% MCL	No.
10 VOCs	Quarterly/Yr; annual after one year of no detect; every 3 years after 3 rounds.		> 0.0005 mg/l	Yes: Based on vulnerability assessment.
18 Pesticides/PCBs	4 quarterly samples every 3 yrs; after 1 round of no detect, systems > 3,300 reduce to 2 samples/yr every 3 yrs; systems < 3,300 reduce to 1 sample every 3 yrs.		Detection, (see Table 23)	Yes: Based on vulnerability assessment.
Unregulated — 6 IOCs, — 24 SOCs	One sample, 4 consecutive quarters		N/A	Yes: Based on vulnerability assessment.

Table 9.—Analytical Methods for Inorganic Chemicals

Contaminant and Methodology

Aluminum:

Atomic absorption; furnace technique ¹Atomic absorption; direct aspiration ²

Asbestos

Transmission electron microscopy

Barium:

Atomic absorption; furnace technique ¹Atomic absorption; direct aspiration ²

Inductively coupled plasma /3/

Cadmium:

Atomic absorption; furnace technique

Inductively coupled plasma ²

Chromium:

Atomic absorption; furnace technique ¹Inductively coupled plasma ²

Mercury:

¹ Graphite Furnace Atomic Absorption Spectroscopy (GFAAS).² Direct Aspiration Atomic Absorption Spectroscopy (AA).³ Inductively Coupled Plasma—Atomic Emission Spectroscopy (ICP-AES).

Manual cold vapor technique
Automated cold vapor technique

Nitrate:

Manual cadmium reduction
Automated hydrazine reduction
Automated cadmium reduction
Ion selective electrode
Ion chromatography¹

Nitrite:

Spectrophotometric
Automated cadmium reduction
Manual cadmium reduction
Ion chromatography

Selenium:

Atomic absorption, gaseous hydride
Atomic absorption, furnace¹

Silver:

Atomic absorption, direct aspiration²
Inductively coupled plasma³

TABLE 10.—ANALYTICAL METHODS FOR
VOLATILE ORGANIC CHEMICALS

EPA methods	Contaminants
502.1	o-Dichlorobenzene
502.2	cis-1,2-Dichloroethylene
503.1	trans-1,2-Dichloroethylene
524.1	1,2-Dichloropropane
524.2	Ethylbenzene
	Monochlorobenzene
	Styrene
	Tetrachloroethylene
	Toluene
	Xylenes

TABLE 11.—ANALYTICAL METHODS FOR
PESTICIDES/PCBS

EPA methods	Contaminants
504	Dibromochloropropane
505	Ethylene dibromide
	Atrazine
	Chlordane
	Heptachlor
	Heptachlor epoxide
	Lindane
	Methoxychlor
	Toxaphene
	PCBs ¹
507	Atrazine
508	Chlordane
	Heptachlor
	Heptachlor epoxide
	Lindane
	Methoxychlor
	PCBs ¹
508A	PCBs (as decachlorobiphenyl)
515.1	2,4-D
	2,4,5-TP (Silvex)
	Pentachlorophenol
525	Atrazine
	Chlordane
	Heptachlor
	Heptachlor epoxide
	Lindane
	Methoxychlor
	Pentachlorophenol
53.1	Aldicarb
	Aldicarb sulfonate
	Aldicarb sulfone
	Carbofuran

Methods 505 and 506 are used as screens only. If detected in 505 or 508, systems must confirm using Method 508A.

TABLE 12.—LABORATORY CERTIFICATION
CRITERIA

IOC's	2 standard deviations based on study statistics
Asbestos	
Barium	±15% at >0.5 mg/l
Cadmium	±20% at >0.002 mg/l
Chromium	±15% at >0.01 mg/l
Fluoride	±10% at 1 to 10 mg/l
Mercury	±30% at >0.0005 mg/l
Nitrate	±10% at >0.4 mg/l
Nitrite	±15% at >0.4 mg/l
Selenium	±20% at >0.01 mg/l
VOC's:	±20% at >0.010 mg/l ±40% at <0.010 mg/l
Pesticides and PCBs:	
Atrazine	±45% at 0.002 mg/l
Atrazine	±45% at 0.001 mg/l
Carbofuran	±45% at 0.007 mg/l
Chlordane	±45% at 0.002 mg/l
Heptachlor	±45% at 0.0004 mg/l
Heptachlor epoxide	±45% at 0.0002 mg/l
Lindane	±45% at 0.0002 mg/l
Methoxychlor	±45% at 0.01 mg/l
PCBs (as Decachlorobiphenyl)	0-200% at 0.0005 mg/l
Aldicarb	±55% at 0.003 mg/l
Aldicarb sulfonate	±55% at 0.003 mg/l
Aldicarb sulfone	±55% at 0.003 mg/l
Toxaphene	±45% at 0.003 mg/l
Pentachlorophenol	±50% at 0.001 mg/l
2,4-D	±50% at 0.005 mg/l
2,4,5-TP	±50% at 0.005 mg/l
EDB	±40% at 0.00005 mg/l
DBCP	±40% at 0.0002 mg/l

TABLE 13.—STATE IMPLEMENTATION
REQUIREMENTS

Requirement	Primacy	Record-keeping	Reporting
Vulnerability assessment procedures ¹	X		
Waiver procedures	X		
Monitoring schedule	X		
Vulnerability assessment determinations		X	
Waivers granted		X	
Treatment technique certifications		X	
Unregulated contaminant results		X	X

¹ Required if States grant waivers.

II. Background

A. Statutory Authority

The Safe Drinking Water Act (SDWA or "the Act"), as amended in 1986 (Pub. L. No. 99-339, 100 Stat. 642), requires EPA to publish "maximum contaminant level goals" (MCLGs) for contaminants which, in the judgment of the Administrator, "may have an adverse effect on the health of persons and

which [are] known or anticipated to occur in public water systems" (section 1412(b)(3)(A)). MCLGs are to be set at a level at which "no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety" (section 1412(b)(4)).

At the same time EPA publishes an MCLG, which is a non-enforceable health goal, it must also promulgate a National Primary Drinking Water Regulation (NPDWR) which includes either (1) a maximum contaminant level (MCL), or (2) a required treatment technique (section 1401(1), 1412(a)(3), and 1412(b)(7)(A)). A treatment technique may be set only if it is not "economically or technologically feasible" to ascertain the level of a contaminant (sections 1401(1) and 1412(b)(7)(A)). An MCL must be set as close to the MCLG as feasible (section 1412(b)(4)). Under the Act, "feasible" means "feasible with the use of the best technology, treatment techniques, and other means which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking cost into consideration)" (section 1412(b)(5)). In setting MCLs, EPA considers the cost of treatment technology to large public water systems (i.e., >1,000,000 people) with relatively clean source water supplies (132 Cong. Rec. S6287 (daily ed., May 21, 1986)). Each NPDWR that establishes an MCL must list the best available technology, treatment techniques, and other means that are feasible for meeting the MCL (BAT) (section 1412(b)(6)). NPDWRs include monitoring, analytical and quality assurance requirements, specifically, "criteria and procedures to assure a supply of drinking water which dependably complies with such maximum contaminant levels . . ." (Section 1401(1)(D)). Section 1445 also authorizes EPA to promulgate monitoring requirements.

Section 1414(c) requires each owner or operator of a public water system to give notice to persons served by it of (1) any failure to comply with a maximum contaminant level, treatment technique, or testing procedure required by a NPDWR; (2) any failure to comply with any monitoring required pursuant to section 1445 of the Act; (3) the existence of a variance or exemption; and (4) any failure to comply with the requirements of any schedule prescribed pursuant to a variance or exemption.

Under the 1986 Amendments to the SDWA, EPA was to complete the promulgation of NPDWRs for 83 contaminants, in three phases, by June

19, 1989. After 1989, an additional 25 contaminants must be regulated every three years (section 1412(b)).

B. Regulatory History

In the 1986 Amendments to the SDWA, Congress required that MCLGs and MCLs be proposed and promulgated simultaneously (section 1412(a)(3)). This change streamlined development of drinking water standards by combining two steps in the regulation development process. Section 1412(a)(2) renamed recommended maximum contaminant levels (RMCLs) as maximum contaminant level goals (MCLGs).

To ensure compliance with the provision that MCLGs and MCLs be proposed and promulgated simultaneously and to ensure adequate opportunity for public comment on these proposed standards, EPA proposed as RMCLs, in November 1983, most of the MCLGs contained in today's rule.

On May 22, 1989, EPA proposed MCLGs and MCLs for 38 contaminants and a treatment technique requirement for two contaminants. Most of the MCLGs and MCLs are promulgated at the same levels as proposed in May 1989. However, the MCLGs and/or MCLs for five contaminants are lower than previously proposed. Where EPA is promulgating MCLGs, MCLs, analytical methods, best available technology, monitoring requirements, and State implementation requirements that differ from the proposal, the changes result from public comments and/or additional data that the preamble indicated were under development or analysis. The technical and/or policy basis for these changes are explained in this notice.

On February 14, 1989, in response to a citizen suit from the Bull Run Coalition, EPA entered into a consent order which requires promulgation of regulations for 40 contaminants by December 31, 1990. EPA on June 19, 1989 partially fulfilled this requirement by promulgating regulations on coliforms and other microbiological contaminants. The promulgation of regulations on the 34 contaminants in today's rule partially fulfills the terms of the consent decree. Because of changed RfDs for aldicarb, aldicarb sulfoxide, aldicarb sulfone, and barium and the reclassification of pentachlorophenol as a B2 carcinogen and placement in Category I, EPA, elsewhere in today's Federal Register, is reproposing the MCLGs and MCLs for these contaminants. EPA intends to promulgate final standards for these chemicals by July, 1991.

C. Public Comments on the Proposal

EPA requested comments on all aspects of the May 22, 1989 proposal. A

summary of the major comments and the Agency's response to the issues raised are presented in the following section. The Agency's detailed response to the comments received are presented in the document "Response to Comments Received on the Proposed Requirements for 35 Contaminants of May 22, 1989," which is in the docket for this rule.

EPA received approximately 170 comments on the proposed MCLGs in the May, 1989 proposal. These comments represented the views of 65 industrial/commercial groups, 47 State governments, 35 local governments and public water systems, 8 public interest groups, 8 federal agencies, as well as comments from individual citizens and academic interests.

EPA held a public hearing on the proposed rule July 12, 1989 in Washington, DC. Fourteen organizations made oral presentations at the public hearing. A transcript of the hearing is available in the docket.

III. Explanation of Today's Action

A. Establishment of MCLGs

Most of the MCLGs promulgated today are at the same level as proposed in May 1989. However, MCLGs (toluene and methoxychlor) are lower than proposed. One contaminant, styrene, originally proposed at levels of zero and 0.1 mg/l is promulgated today at a level of 0.1 mg/l. EPA is reproposing lower MCLGs based upon revised RfDs elsewhere in today's Federal Register for five contaminants. The basis for that change is explained in that notice. Where EPA in this notice is promulgating MCLGs that differ from previously proposed MCLGs, the changes result from public comments and/or data or that the preamble indicated were under development or analysis. An explanation of these changes is included in this notice. In this notice, EPA is responding to the major issues raised in public comments. For EPA's complete response to all issues raised in comments, EPA refers the reader to the Comment/Response Document found in the Phase II docket.

For a number of the contaminants, EPA had previously responded to issues raised in response to the November 1983 notice in the May 1989 proposal. For the most part, these responses are not repeated in this notice unless additional information was provided to the Agency. Where comments were previously responded to, EPA refers the reader to the May 1989 proposal. For four contaminants, no major issues were raised and no new information was obtained by the Agency that would cause it to change the MCLGs from the

level proposed in May 1989. For these contaminants (EDB, toxaphene, 2,4,5-TP, and epichlorohydrin), final MCLGs are promulgated without additional comment.

For contaminants classified in Category II, EPA currently considers two options for setting the MCLG as described in 50 FR 40949, November 13, 1985. The lead option is to set the MCLG based on noncarcinogenic endpoints (the RfD adjusted for an adult drinking an average of 2 L water/day over a lifetime) if adequate data exist. To account for possible carcinogenicity, an additional uncertainty factor of up to 10 is applied. If adequate noncarcinogenic data are not available (i.e., asbestos), the second option consists of setting the MCLG in the theoretical excess cancer risk range of 10^{-6} to 10^{-7} . EPA is currently evaluating the appropriateness of the two options for establishing MCLGs (see 55 FR 39376, p. 39404). However, the MCLGs promulgated today use the RfD option with an application of an additional uncertainty factor up to 10, except as noted for asbestos.

1. How MCLGs Are Developed

MCLGs are set at concentration levels at which no known or anticipated adverse health effects would occur, allowing for an adequate margin of safety. Establishment of a specific MCLG depends on the evidence of carcinogenicity from drinking water exposure or the Agency's reference dose (RfD), which is calculated for each specific contaminant.

The cancer classification for a specific chemical and the reference dose are adopted by two different Agency groups. Decisions on cancer classifications are made by the Cancer Risk Assessment Verification Endeavor (CRAVE) group, which is composed of representatives of various EPA program offices. Decisions on EPA reference doses (using non-cancer endpoints only) are made through the Agency Reference Dose work group, also composed of representatives of various EPA program offices. Decisions by CRAVE and the RfD groups represent policy decisions for the Agency and are used by the respective regulatory programs as the basis for regulatory decisions. Decisions of these two groups are published in the Agency's Integrated Risk Information System (IRIS). This system can be accessed by the public by contacting Mike McLaughlin of DIALCOM, Inc. at 202-462-6559.

The RfD is an estimate, with an uncertainty spanning perhaps an order of magnitude, of a daily exposure to the

human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious health effects during a lifetime. The RfD is derived from a no- or lowest-observed-adverse-effect level (called a NOAEL or LOAEL, respectively) that has been identified from a subchronic or chronic scientific study of humans or animals. The NOAEL or LOAEL is then divided by the uncertainty factor to derive the RfD.

The use of an uncertainty factor is important in the derivation of the RfD. EPA has established certain guidelines (shown below) to determine which uncertainty factor should be used:

10—Valid experimental results for appropriate duration. Human exposure.

100—Human data not available. Extrapolation from valid long-term animal studies.

1,000—Human data not available. Extrapolation from animal studies of less than chronic exposure.

1-10—Additional safety factor for use of a LOAEL instead of a NOAEL.

Other—Other uncertainty factors are used according to scientific judgment when justified.

In general, an uncertainty factor is calculated to consider intra- and interspecies variations, limited or incomplete data, use of subchronic studies, significance of the adverse effect, and the pharmacokinetic factors.

From the RfD, a drinking water equivalent level (DWEL) is calculated by multiplying the RfD by an assumed adult body weight (generally 70 kg) and then dividing by an average daily water consumption of 2 L per day. The DWEL assumes the total daily exposure to a substance is from drinking water exposure. The MCLG is determined by multiplying the DWEL by the percentage of the total daily exposure contributed by drinking water, called the relative source contribution. Generally, EPA assumes that the relative source contribution from drinking water is 20 percent of the total exposure, unless other exposure data for the chemical are available. The calculation below expresses the derivation of the MCLG:

$$RfD = \frac{\text{NOAEL or LOAEL}}{\text{uncertainty factor}} = \frac{\text{mg/kg/body weight/day}}{\text{day}} \quad (1)$$

$$DWEL = \frac{RfD \times \text{body weight}}{\text{daily water consumption in L/day}} = \text{mg/L} \quad (2)$$

$$MCLG = DWEL \times \text{drinking water contribution} \quad (3)$$

For chemicals suspected as carcinogens, the assessment for nonthreshold toxicants consists of the weight of evidence of carcinogenicity in humans, using bioassays in animals and human epidemiological studies as well as information that provides indirect evidence (i.e., mutagenicity and other short-term test results). The objectives of the assessment are (1) to determine the level or strength of evidence that the substance is a human or animal carcinogen and (2) to provide an upperbound estimate of the possible risk of human exposure to the substance in drinking water. A summary of EPA's carcinogen classification scheme is:

Group A—Human carcinogen based on sufficient evidence from epidemiological studies.

Group B1—Probable human carcinogen based on at least limited evidence of carcinogenicity to humans.

Group B2—Probable human carcinogen based on a combination of sufficient evidence in animals and inadequate data in humans.

Group C—Possible human carcinogen based on limited evidence of carcinogenicity in animals in the absence of human data.

Group D—Not classifiable based on lack of data or inadequate evidence of carcinogenicity from animal data.

Group E—No evidence of carcinogenicity for humans (no evidence for carcinogenicity in at least two adequate animal tests in different

species or in both epidemiological and animal studies).

Establishing the MCLG for a chemical is generally accomplished in one of three ways depending upon its categorization (Table 14). The starting point in EPA's analysis is the Agency's cancer classification (i.e., A, B, C, D, or E). Each chemical is analyzed for evidence of carcinogenicity via ingestion. In most cases, the Agency places Group A, B1, and B2 contaminants into Category I, Group C into Category II, and Group D and E into Category III. However, where there is additional information on cancer risks from drinking water ingestion (taking into consideration weight of evidence, pharmacokinetics and exposure) additional scrutiny is conducted which may result in placing the contaminant into a different category. Asbestos and cadmium are examples where the categorization was adjusted based on the evidence of carcinogenicity via ingestion. In the case of chromium, where there is uncertainty in the ingestion data base, the Agency used the RfD approach (described below) to derive an MCLG even though the chemical has not been categorized. This issue is discussed below. Where there is no additional information on cancer risks from drinking water ingestion to consider, the Agency's cancer classification is used to categorize the chemical. In the cases of styrene and tetrachloroethylene, where the Agency's cancer classification is unresolved, EPA used its categorization approach to derive an MCLG.

EPA's policy is to set MCLGs for Category I chemicals at zero. The MCLG for Category II contaminants is calculated by using the RfD/DWEL with an added margin of safety to account for cancer effects or is based on a cancer risk range of 10^{-5} to 10^{-6} when non-cancer data are inadequate for deriving an RfD. Category III contaminants are calculated using the RfD/DWEL approach.

TABLE 14.—EPA'S THREE-CATEGORY APPROACH FOR ESTABLISHING MCLGS

Category	Evidence of carcinogenicity via ingestion	MCLG setting approach
I	Strong evidence considering weight of evidence, pharmacokinetics, and exposure.	Zero.
II	Limited evidence considering weight of evidence, pharmacokinetics, and exposure.	RfD approach with added safety margin or 10^{-5} to 10^{-6} cancer risk range
III	Inadequate or no animal evidence	RfD approach.

The MCLG for Category I contaminants is set at zero because it is assumed, in the absence of other data, that there is no known threshold. Category I contaminants are those contaminants which EPA has determined that there is strong evidence of carcinogenicity from drinking water ingestion. If there is no additional information to consider on potential cancer risks from drinking water ingestion, chemicals classified as A or B carcinogens are placed in Category I.

Category II contaminants include those contaminants which EPA has determined that there is limited evidence of carcinogenicity via drinking water ingestion considering weight of evidence, pharmacokinetics, and exposure. If there is no additional information to consider on potential cancer risks from drinking water ingestion, chemicals classified by the Agency as Group C carcinogens are placed in Category II. For Category II contaminants two approaches are used to set the MCLGs—either (1) setting the goal based upon noncarcinogenic endpoints (the RfD) then applying an additional uncertainty (safety) factor of up to 10 or (2) setting the goal based upon a nominal lifetime cancer risk calculation in the range of 10^{-6} to 10^{-4} using a conservative calculation model. The first approach is generally used; however, the second is used when valid noncarcinogenicity data are not available and adequate experimental data are available to quantify the cancer risk. EPA is currently evaluating its approach to establishing MCLGs for Category II contaminants.

Category III contaminants include those contaminants for which there is inadequate evidence of carcinogenicity via ingestion. If there is no additional information to consider, contaminants classified as Group D or E carcinogens are placed in Category III. For these contaminants, the MCLG is established using the RfD approach.

2. Response to Comments on EPA's Zero MCLG Policy

The purpose of MCLGs under the SDWA is to set goals for both carcinogens and noncarcinogens, at a level at which "no known or anticipated adverse effects on the health of persons occur and which allow an adequate margin of safety." SDWA section 1412(b)(4). In its rulemaking on volatile synthetic organic chemicals (VOCs), the Agency articulated its policy of setting MCLGs at zero for known and probable human carcinogens. See 47 FR 9350 (March 4, 1982), 49 FR 24330, at 24343 (June 12, 1984) and 50 FR 46880, at 46885 (Nov. 13, 1985). Multinational Business

Services, Inc. (MBS) asked the Agency to reconsider this policy which MBS considered a departure from the consistent application of risk assessment principles by federal agencies in regulating carcinogens. Instead, MBS recommended that EPA establish MCLGs for such contaminants at calculated negligible risk levels. In the May, 1989 proposal of today's rule, the Agency indicated that it intended to continue the zero MCLG policy. At the same time, the Agency agreed to address the MBS request and any other comments on the policy.

In the VOCs rulemaking, the Agency considered three major options (and several variations) for setting MCLGs (then called "recommended maximum contaminant levels") for the carcinogenic VOCs. These were: zero MCLGs, MCLGs set at the analytical detection limit, and MCLGs set at non-zero levels based on calculated negligible contribution to lifetime risks. (50 FR 46880, at 46884.) The Agency recognized that humans can tolerate and detoxify a certain threshold level of noncarcinogens, and therefore found it appropriate to set MCLGs for the noncarcinogenic VOCs above zero. However, in the Agency's view a threshold for the action of potential carcinogens could not be demonstrated by current science; it was conservatively assumed that no threshold exists, absent evidence to the contrary. *Id.* Any exposure to carcinogens might represent some finite level of risk, the magnitude of which would depend on dosage and potency of the particular carcinogen. Under these circumstances, in the Agency's judgment, an MCLG above zero did not meet the statutory requirement that the goal be set where no known or anticipated adverse effects occur or allow an adequate margin of safety.

The Agency believed that MCLGs of zero for the carcinogens would also best reflect the Agency's general philosophy that, as a goal, carcinogens should not be present in drinking water. Moreover, the legislative history of the SDWA specifically authorized this regulatory option. "The (MCLG) must be set to prevent the occurrence of any known or anticipated adverse effect. It must include an adequate margin of safety, unless there is no safe threshold for a contaminant. In such a case the (MCLG) should be set at the zero level." (H.R. Rep. No. 1185, 93d Cong., 2d Sess. 20 (1974), reprinted in "A Legislative History of the Safe Drinking Water Act," 1982 at 562.) EPA's decision to promulgate zero MCLGs for the carcinogenic VOCs was upheld in the

"VOCs decision." *Natural Resources Defense Council v. Thomas*, 824 F.2d 1211 (D.C. Cir., 1987). (EPA's determination was "well within the bounds of its authority" under the SDWA. *Id.* at 1213).

Comments on the zero MCLG issue in the May 1989 proposal were received from eighteen commenters in addition to MBS. Virtually all of the issues in these comments have been raised and addressed earlier. See 49 FR 24330 (June 12, 1984) and 50 FR 46885 (Nov. 13, 1985).

MBS and other commenters disagree with the Agency's interpretation of the statutory standard to set MCLGs at a level to prevent the occurrence of any known or anticipated adverse health effects with an adequate margin of safety. These commenters argue that Congress intended MCLGs to give "reasonable," not "absolute," assurance against adverse health effects. MBS and others maintain that health effects are not "anticipated" absent evidence indicating they should be expected. We note that the House Report cited earlier indicates that "the Administrator must decide whether any adverse effects can be reasonably anticipated, even though not proved to exist." H.R. Rep. No. 1185, *id.* Some commenters are critical of the Agency's "reliance" on the House Report language addressing the situation where there is no known safe threshold. These commenters argue that EPA's interpretation is "inconsistent" with other legislative history. MBS, for example, cites the House Report discussion of a study to be conducted by the National Academy of Sciences (NAS) to support its position that Congress did not intend MCLGs to be set at zero. The Committee directed NAS to develop recommendations of maximum contaminant levels "solely on considerations of public health" and not to be "influenced by political, budgetary, or other considerations." *Id.*, at 551. In recommending an adequate margin of safety, NAS was to consider, among other factors, the margins of safety used by other regulatory systems. *Id.* However, as the Committee made clear, determining an adequate margin of safety was but the final step in the process of setting an MCLG. The Administrator must first decide if any adverse health effects can reasonably be anticipated, even though not proved to exist. It was necessary to determine an adequate margin of safety only if there is a safe threshold for the contaminant. If there is no safe threshold, the MCLG "should be set at the zero level." *Id.*, at 552. We find nothing in the discussion of the NAS study to contradict the Committee's

explicit recognition of the fact that there may be circumstances where there is no safe threshold for a contaminant.

Some commenters maintain that the Agency's interpretation of the SDWA should be determined by interpretations of other statutes that direct agencies to set "safe" standards. In this regard, several commenters point to the "vinyl chloride decision" construing section 112 of the Clean Air Act (CAA). *Natural Resources Defense Council, Inc. v. EPA*, 824 F.2d 1146 (D.C. Cir. 1987). Pursuant to section 112 of the CAA, the Administrator sets emission standards "at the level which in his judgment provides an ample margin of safety to protect the public health." The court found that use of the term "safety" is significant evidence that Congress "did not intend to require the Administrator to prohibit all emissions of non-threshold pollutants." 824 F.2d at 1153. The court cited the Supreme Court's "benzene decision" for the proposition that "safe" does not mean "risk free" and that something is "unsafe" only when it threatens humans with "a significant risk of harm." *Industrial Union Dept. AFL-CIO v. American Petroleum Inst.*, 448 U.S. 607, 640 (1980). MBS argues that the "vinyl chloride decision" is particularly compelling since the term "margin of safety" appears in both section 112 of the CAA and section 1412 of the SDWA. However, the court in the "VOCs decision" noted that the Supreme Court's "benzene decision" was based on "a close reading of the statutory language of OSHA, which we note differs significantly from the statutory scheme that we confront in this case. The OSHA language that the Supreme Court interpreted as incorporating a requirement of a finding of significant risk directed the Secretary to set standards 'reasonably necessary and appropriate to provide safe or healthful employment'." 824 F.2d at 1215-1216. Accordingly, there must be a threshold determination that the place of employment is "unsafe" in the sense that significant risks are present and can be eliminated or lessened by changing practices. 824 F.2d at 1215. The court in the "VOCs decision" found that this "significant risk" standard did not apply to the Administrator's decisions to regulate contaminants under the SDWA. 824 F.2d 1211, 1216.

We have followed a similar restraint in importing interpretations from other statutes on the basis that they are "analogous." It remains our view that reliance on such interpretations as determinative of Congressional intent in enacting the SDWA is unwarranted.

Section 112 of the CAA and other statutes cited by commenters are not "the same as" section 1412 of the SDWA. They do not have a two-step regulatory process consisting of separate, aspirational goals, followed by achievable, enforceable limits. Feasibility, cost and other factors may be relevant to determining appropriate enforcement levels under the CAA and other statutes and may influence the concept of "safety." Such factors are not appropriate in setting MCLGs. Some commenters point out that EPA has determined that standards reflecting a 10^{-4} to 10^{-6} risk level are safe and protective of public health even for known or probable carcinogens under other of its authorities. That is true, but such determinations are not inconsistent with our position that MCLGs serve fundamentally different purposes than enforceable standards.

MBS and a few other commenters also suggest that the Agency's general assumption of no biological threshold of effect for carcinogens is not appropriate. MBS maintains there is "an increasing body of scientific data" indicating that substances that elicit carcinogenic response in laboratory animals "actually appear to have a threshold of effect for humans." EPA will continue to solicit the best scientific views and encourages the public to provide such evidence to the Agency for consideration. EPA intends to set MCLGs based upon the most current scientific data, and is open to revising current levels based upon new data.

Some comments indicate concern that zero MCLGs are impractical since they are undetectable and unachievable. It remains our view that MCLGs are, by statute, different from enforceable standards; as goals based solely on health factors they need not be measurable, affordable or achievable. Some commenters maintain that even as unenforceable goals, MCLGs have serious practical implications. They argue that zero MCLGs cause undue public alarm and will result in the misallocation of funds to reduce certain contaminants. We believe the distinction between aspirational goals and standards enforceable under the SDWA is significant and understandable. We also believe that those who adopt MCLGs for purposes outside the SDWA or use MCLGs as operational standards rather than aspirational goals do so knowingly; those decisions cannot influence the Agency's setting of MCLGs. In this context, some commenters argue that zero MCLGs will have dire financial results for Agency clean-up actions. We

cannot agree with such a broad prediction. EPA has determined that MCLGs of zero are not relevant and appropriate requirements for Superfund cleanups. Contaminant levels of zero are not consistent with cleanup objectives of CERCLA. See 55 FR 8666, 8750 (March 8, 1990).

Some commenters maintain that zero MCLGs will necessarily drive MCLs to increasingly stringent enforceable standards as technology improves and that such standards are not justified by their health benefits. The SDWA provides that MCLs shall be set as close as feasible to the MCLGs, taking cost into account. While it is true that an MCL for a contaminant with a zero MCLG has a greater potential to ultimately be more stringent than an MCL for a contaminant with an MCLG above zero, a number of factors are considered in determining what constitutes "best available technology" on which to base the MCLs. Moreover, while resources should be directed toward highest risks, it seems premature to conclude that the resources that may be necessary to achieve such standards would be misdirected.

In the opinion of EPA, Category I contaminants meet the "no safe threshold" test established in the House Report. EPA does not automatically place contaminants classified as Group A or B carcinogens in Category I. Additional scrutiny occurs to determine what evidence exists of the chemicals' carcinogenicity via ingestion considering pharmacokinetics, exposure, and weight of evidence. If the additional evidence indicates that the overall evidence of carcinogenicity via ingestion is limited or inadequate, then the chemical will be placed in the appropriate category and an MCLG is calculated accordingly. For contaminants placed in Category II, the MCLG is based on non-carcinogenic effects using the RfD approach. An extra margin of safety of 1- to 10-fold is used to account for the possible carcinogenic effects of these Category II contaminants. If data are inadequate to establish an RfD, then EPA uses a 10^{-5} to 10^{-6} cancer risk range to establish the MCLG.

EPA recognizes that other Federal, State and public health agencies have used a risk-based approach for regulating carcinogens. As discussed above, EPA does use a risk-based approach as an alternative methodology for Category II contaminants when non-cancer health effects data are inadequate to establish an RfD (i.e., asbestos). Currently EPA is considering adopting this risk-based alternative as

the primary approach for Category II contaminants in future regulations (see 55 FR 30374, July 25, 1990).

In addition, when EPA establishes MCLs, it considers the cancer risk at the MCL to determine whether they would be acceptable from a safety standpoint. A target risk range of 10^{-4} to 10^{-6} is considered by EPA to be safe and protective of public health.

EPA agrees that MCLGs at zero do not provide specific information on potency and mechanism of action; however, EPA does consider potency and mechanism of action on a chemical-specific basis in determining whether there is strong (Category I) or limited (Category II) evidence of carcinogenicity. EPA recognizes that achieving zero levels of

carcinogens in our water supplies or in other media is not possible; MCLGs are health goals. Consequently, EPA believes that reducing the drinking water exposure to carcinogens should lead to an overall reduction in the daily exposures to a compound.

In conclusion, when current scientific data do not show a safe threshold, it remains Agency policy that a zero MCLG for known or probable human carcinogens best reflects the statutory directive to establish a level at which no known or anticipated adverse effects on health occurs. At the same time, we are mindful that significant advances are being made in scientific knowledge and technology that allow us to know more about the process of carcinogenicity and

to detect contaminants at increasingly lower levels. We are continuing to evaluate these advances to determine whether it is possible to define levels that have little or no meaning in terms of cancer risk. If so, the Agency may determine that the SDWA directive of "no adverse effects" could be met by other than zero MCLGs.

3. Relative Source Contribution

Table 15 summarizes the approach EPA uses to estimate the relative contribution from other sources of exposure, including air and food, for the purpose of calculating the MCLG for non-carcinogens. EPA requested comments on this approach.

TABLE 15.—RELATIVE SOURCE CONTRIBUTION

	Drinking water exposure between 20 and 80%	Drinking water exposure between 80 and 100%	Drinking water exposure less than 20%
Adequate data are available	EPA uses actual data.....	EPA uses an 80% drinking water contribution.	EPA uses a 20% drinking water contribution.
Adequate data are not available		EPA uses a 20% drinking water contribution.	

Five commenters fully supported EPA's proposed approach for developing and using relative source contribution (RSC) factors. One of these commenters agreed that volatilization data are currently inadequate for use in establishing RSCs. Another commenter believed sufficient data and modeling techniques for volatilization have been published and that human exposure from volatilization of drinking water could range from 3 to 10 times that from ingestion. Another commenter believed current information indicates that the vast majority of human exposure to drinking water contaminants occurs from ingestion; therefore, EPA should not consider volatilization in developing RSC factors. One commenter noted that the majority of contaminants volatilized from drinking water would not be inhaled. One commenter stated that EPA should refine its models on skin contact and inhalation using a workshop format, present the models to the Science Advisory Board, and publish the models for public comment. Many divergent comments were received on the use of a 20 percent floor and 80 percent ceiling (see Comment/Response Document for details). Several commenters objected to using a 20 percent floor and 80 percent ceiling for the RSC when actual data are available. One commenter asked EPA to clarify that the 20 percent floor accounts for all routes of exposure to drinking water

contaminants (i.e., inhalation, dermal absorption, and ingestion).

EPA Response: EPA has not completed the modeling effort for estimating drinking water exposure from volatilization and dermal absorption. The draft document "Guidelines for Incorporation of Inhalation and Dermal Exposures from Drinking Water in the Calculation of Health Advisory and DWEL Values" (U.S. EPA, 1989, draft) is undergoing internal Agency review. After completion of Agency review, the document will be available for Science Advisory Board and external review. In the meantime, EPA maintains the position that exposure to drinking water contaminants from volatilization and dermal absorption is generally limited and adequately accounted for in the selection of relative source contribution factors. EPA believes that the 20 percent floor is very protective and represents a level below which additional incremental protection is negligible. In addition, below 20 percent RSC from water is a clear indication that control of other more contaminated media will have a significantly greater reduction in exposure. EPA believes the 80 percent ceiling is required because, even if nearly all exposure is currently via drinking water, some portion, albeit small, of the adjusted daily intake (ADI) should be reserved to protect populations with unusual exposures and future changes in the distribution of the contaminant in the environment. EPA

does not rely on the limits when adequate exposure data exist between 20 and 80 percent, but when data are not adequate, the 20 percent floor and 80 percent ceiling are prudent and protective of public health.

4. Inorganic MCLGs

a. Asbestos. EPA proposed an MCLG of 7 million fibers/liter (rounded off from 7.1 million) for asbestos fibers exceeding 10 micrometers in length since sufficient health and occurrence data exist to justify a national regulation and the 1986 SDWA Amendments require the Agency to regulate this contaminant. EPA's proposal of 7 million fibers/liter (for fibers greater than 10 micrometers in length) is based upon evidence of benign polyps occurring in male rats following the oral administration of intermediate (> 10 micrometer range) size chrysotile fibers.

Public Comments. A total of 19 individuals or organizations provided comments in response to the MCLG proposal regarding asbestos. A number of commenters (13) stated that, while recognizing the health hazards associated with inhalation exposure, it was not appropriate to develop an MCLG for asbestos due to the inadequacy of data establishing health risks via ingestion of asbestos. Four commenters stated that asbestos should not be considered as having "limited" evidence of carcinogenicity (Group C), but instead should be placed in "Group

D" with the MCLG based on the No-Observed Adverse-Effect Level (NOAEL) or Lowest-Observed-Adverse-Effect Level (LOAEL) for ingested asbestos. One commenter recommended developing a health advisory based on available data instead of proposing an MCLG for asbestos. Another commenter objected to asbestos carcinogenic classification (limited evidence, Group C) in view of the EPA's classification of inhaled asbestos as Group A (known human carcinogen) and recommended an MCLG of zero.

EPA Response. EPA recognizes that the evidence for the health effects of ingested asbestos has limitations. However, EPA believes that there is a sufficient basis to justify regulating asbestos for the reasons outlined in the November 13, 1985, notice. Furthermore, the 1986 SDWA amendments direct EPA to regulate asbestos. The reasons outlined in the aforementioned November 13, 1985, notice are summarized below:

- Asbestos has been shown to be a human carcinogen through inhalation exposure and is classified by EPA as Group A (human carcinogen).
- The results of the National Toxicology Program (NTP) bioassay showed an association between the ingestion of asbestos fibers 65 percent of which were greater than 1 micrometers in length and benign gastrointestinal tumors (adenomatous polyps) in male rats. A parallel NTP study of fibers, 98 percent of which were <10, did not produce a response in male or female rats.
- Although these results were not statistically significant compared with the concurrent controls, the incidence of the neoplasms was highly significant when compared with the incidence of epithelial neoplasms (benign and malignant combined) of the large intestine of the pooled control groups of all the NTP oral asbestos lifetime studies.

• The EPA Science Advisory Board (SAB) stated that "given the positive signal seen in some epidemiologic studies, plus well-documented evidence for the association between asbestos fiber inhalation and lung cancer, it is hard for the Committee to feel comfortable in dismissing the possibility of an increased risk of gastrointestinal cancer in humans exposed to asbestos fibers from drinking water."

• EPA believes the above information substantiates the health significance of asbestos fibers associated with both inhalation and ingestion as routes of exposure. Therefore, this evaluation of the health significance of asbestos fibers

in drinking water is not inconsistent with the proposed MCLG for asbestos.

In addition, The National Research Council (NRC, 1984. Nonoccupational Health Risk of Asbestiform Fibers) concluded "the association of asbestos with an increased risk of malignancies other than lung cancer and mesothelioma has not been confirmed in animal studies and has not been observed consistently in human studies."

In setting an MCLG for asbestos in drinking water, EPA believes the limitations of the available dose-response data from dietary ingestion of asbestos justifies treating asbestos as a Category II contaminant. EPA is promulgating an MCLG of 7 million fibers/liter (>10 micrometer in length) for asbestos following review of public comments.

b. Cadmium. In the 1989 proposal (54 FR 22082), EPA repropoed an MCLG of 0.005 mg/l for cadmium. This value was based upon a DWEL of 0.018 mg/l using human renal dysfunction as an endpoint.

Public Comment. Comments on the proposal were received arguing that (a) the current interim 0.01 mg/l standard should be retained or possibly increased, (b) cadmium in drinking water should be regulated as a carcinogen and thus the MCLG should be set at zero, or (c) cadmium produces learning disabilities, birth defects, and heart disease and thus the MCLG should be set at zero.

Those who supported retaining the current interim 0.01 mg/l standard or a higher value based their argument on a variety of points, including the following: (a) The interim 0.01 mg/l standard is safe, and/or (b) the current 0.01 mg/l standard is supported by the conclusion of the World Health Organization (WHO) that the provisional tolerable weekly intake for cadmium should be established at a level not to exceed 0.4–0.5 mg/person.

Those who argued that cadmium in drinking water should be regulated as a Group I carcinogen (i.e., set the MCLG at zero), collectively, provided an extensive analysis of the oncogenic potential of cadmium via non-ingestion routes of exposure in agreement with EPA's own analysis.

An additional commenter argued that the standard should be zero, as cadmium produces learning disabilities, birth defects, and heart disease, but the commenter provided no data adequate to conclude that the proposed standard would not protect against such adverse effects should they occur.

EPA Response. While a level of 0.01 mg/l is probably without effect in most individuals, EPA is not convinced that a

level of 0.01 mg/l or higher contains an adequate margin of safety to protect sensitive subpopulations as required by the SDWA. As noted in the 1989 proposal, WHO recommends 0.005 mg cadmium/l of drinking water, a value identical to the proposed MCLG; the 0.4–0.5 mg/person value cited in the comments principally concerns the diet which, in EPA's opinion, is not relevant to a drinking water standard.

As stated in the 1989 proposal, EPA classified cadmium in Group B1, probable human carcinogen, based upon animal and human evidence of lung cancer from inhalation exposure. Chronic oral animal studies with cadmium have shown kidney damage but no carcinogenic activity and ingestion-specific human data are not available. Therefore, in setting an MCLG for cadmium in drinking water, EPA believes the lack of cancer dose-response evidence from ingestion of cadmium justifies considering cadmium as a Category III contaminant. Those comments that conclude that cadmium is a carcinogen provide no new evidence that cadmium is carcinogenic via drinking water but rather, argue that it is prudent to assume that cadmium is carcinogenic via ingestion. As drinking water studies in rats of two cadmium salts have not shown a dose-response basis for risk (e.g., ATSDR, 1989), EPA believes that for drinking water purposes cadmium should be a Category III contaminant (chronic toxicity but lacking evidence of carcinogenicity).

The commenter arguing that cadmium produces learning disabilities, birth defects, and heart disease provides no convincing evidence that the proposed standard would not protect against such effects should they occur at higher levels of exposure. EPA disagrees that the MCLG should be set at zero on this basis.

After reviewing the public comments, EPA has concluded that cadmium should be placed in Category III and that an MCLG of 0.005 mg/l for cadmium, as proposed, based on the most sensitive endpoint is appropriate.

c. Chromium. In the 1989 proposal (54 FR 22082), EPA repropoed an MCLG of 0.1 mg/l for total chromium (chromium III and VI).

Public Comment. Comments were received that recommended that (a) the 0.1 mg/l value be adopted, (b) separate standards be adopted for Cr VI and Cr III as there is no evidence that Cr III is oxidized to Cr VI in drinking water, and (c) chromium be considered potentially carcinogenic to humans via the oral route; thus, EPA should promulgate an MCLG of zero for chromium.

EPA Response: The 1989 proposal stated that "EPA's Office of Research and Development has shown Cr III to oxidize to Cr VI in the presence of an oxidant such as chlorine at concentrations similar to those used to disinfect drinking water." EPA maintains this view despite some public commenters who state that there is no evidence that Cr III is oxidized to Cr VI.

Those commenters who argued that chromium is carcinogenic, in part, support EPA's conclusion that Cr VI is carcinogenic following exposure by inhalation. From a hazard identification perspective, EPA has classified Cr VI in Group A, i.e., a human carcinogen via inhalation, and considers Cr VI to have various genotoxic characteristics including being a mutagen and clastogen. In comparison, the evidence for Cr III is largely non-positive or equivocal and is viewed as inadequate to develop more clear conclusions. Notably Cr III in trace amounts is an essential nutrient for the metabolism of carbohydrates.

Specific dose-response evidence for Cr VI carcinogenicity by oral exposure is not available at this juncture. Commenters did not present any new information on this point. In comparison, the body of dose-response evidence for inhalation exposure is relatively large and consists mainly of human data. The data base comes from epidemiologic studies of chromate and ferrochromium production workers, chrome pigment workers, and chrome platers where the predominant chromium species is Cr VI. While lung cancer is the focus of these studies, there is also some evidence of an increased hazard of gastrointestinal tract cancer suggesting that respiratory clearance and swallowing or some other physiologic distribution of a reactive chromium species is taking place. Unfortunately, most studies did not investigate or did not detect the presence of any clear dose-response relationships, nor is it obvious that other specific confounding factors for the possible gastrointestinal hazards were accounted for.

While oxidation of Cr III to Cr VI may occur in the water treatment system, reduction of Cr VI to Cr III occurs in mammals. The saliva and gastric juice in the upper alimentary tract of mammals, including humans, have a varied capability to reduce Cr VI with the gastric juice having a notably high capacity. To the extent that Cr VI survives these reduction environments other organs/tissues such as the liver, red blood cells and some lung cells are also reducing environments. Thus, the body's normal physiology provides

detoxification for Cr VI, which provides protection from the oral toxicity of Cr VI.

EPA recognizes that by focusing on total chromium the issues of chromium species-specific toxicity, e.g., carcinogenicity, become mixed. We note that Cr III and Cr VI chemistry is already intertwined in the water treatment process since the two valence states of chromium are in a dynamic equilibrium with the degree of oxidation depending on such factors as pH, dissolved oxygen, or the presence of reducing agents. Other equilibria exist in the mammalian system and thus a clear separation of Cr III and Cr VI is not feasible at this time.

The lack of available Cr VI dose-response information for oral exposure precludes an estimation of the possible magnitude of cancer risk, if any, from drinking water exposure. The available information shows that the capacity for reduction of Cr VI to Cr III can be quite high relative to expected drinking water levels of total chromium. There is, however, insufficient information to describe the rates of reduction and the temporal fate of free or biologically available Cr VI. Since Cr VI is preferentially absorbed compared to Cr III, the amount of biologically available Cr VI is uncertain.

EPA concludes that the presence of Cr VI in drinking water should be minimized in recognition of its biological reactivity including its potential for a carcinogenic hazard. Such minimization will limit the likelihood of saturating the normal reduction/detoxification mechanisms in humans and likewise limit the systemic absorption of any residual Cr VI. Without the necessary information to further evaluate the possibility of carcinogenic risk, EPA believes that drinking water exposure limitations for total chromium based upon other, i.e., non-carcinogenic, health endpoints is the only feasible approach to follow at this time.

The MCLG for total chromium is developed from health effects data for Cr VI, the more toxic chromium species, and is based on EPA's RfD methodology (see 1989 proposal). Since the MCLG includes both Cr III and Cr VI, no category has been assigned for total chromium due to some of the issues discussed earlier. Should new information become available which adequately demonstrates the cancer risk from ingestion of Cr VI, the MCLG for total chromium would be reexamined, especially since Cr VI levels can predominate from spills, uncontrolled waste sites, or geologic formations of Cr VI makeup. Therefore, EPA is

promulgating an MCLG of 0.1 mg/l (100 µg/l), as proposed in 1989, and further recommends that the µ uncertainty regarding Cr VI carcinogenic risk warrants additional investigation.

The MCLG level also falls into the estimated safe and µ adequate daily dietary intake range of 50 to 200 µg/day for Cr III established by the National Research Council in the National Academy of Sciences (NAS, 1989). The lower limit is based on the absence of deficiency symptoms in individuals consuming an average of 50 µg/day chromium. The upper limit was identified from several studies where no adverse effects were noted in individuals consuming 200 µg/day chromium. Consequently, for the reasons stated above, EPA promulgates an MCLG of 0.1 mg/l, as proposed.

d. Mercury. EPA proposed an MCLG of 0.002 mg/l for mercury in the May 22, 1989 proposal. The MCLG was derived from a DWEL of 0.01 mg/l applying a 20 percent contribution from drinking water. The EPA held a workshop on issues regarding the DWEL for mercury (EPA, Peer Review Workshop on Mercury Issues, Summary Report, October 28-27, 1987). The workshop considered three major studies (Druet et al., 1978; Andres P., 1984; Bernaudin et al., 1981) using the same endpoints (kidney damage) for mercury toxicity. The workshop concluded that 0.01 mg/l was an appropriate level for the DWEL.

Public Comments: EPA addressed the public comments received in response to the previous proposal of November 13, 1985 in the Federal Register Notice of May 22, 1989. In response to the Federal Register Notice of 1989, one commenter questioned the use of the studies by EPA for the calculation of DWEL and recommended the use of the Fitzhugh et al. (1950) study instead. The Fitzhugh study noted damage to the kidneys as did the studies selected by EPA. The NOAEL from the Fitzhugh study was 0.315 mg/kg as compared to the LOAEL of 0.32 mg/kg from which EPA derived the DWEL.

EPA Response: EPA examined the Fitzhugh study and found it inappropriate for DWEL determination because of the lack of reporting on which adverse health effects were observed in each dosing group. Consequently, EPA will continue to base its MCLG on the three studies previously cited. Thus, EPA has placed mercury in Category III and promulgates an MCLG of 0.002 mg/l in drinking water.

e. Nitrate/Nitrite. In the 1989 proposal (54 FR 22062), EPA proposed MCLGs of

10 mg/l (as N) for nitrate and 1 mg/l (as N) for nitrite, and, in addition, proposed that the sum of nitrate and nitrite shall not exceed 10 mg/l (as N). EPA based the MCLGs on the toxicity of nitrate in humans due to the reduction of nitrate to nitrite in the human body. By reacting with hemoglobin, nitrite forms methemoglobin (met Hb), which will not transport oxygen to the tissues and thus can lead to asphyxia (i.e., blue babies) which, if sufficiently severe, can lead to death. The current standard for nitrate, which was promulgated in 1975, was based on the previous Public Health Standard which, in turn, was based on a literature survey [Walton, G. 1951. "Survey of Literature Relating to Infant Methemoglobinemia Due to Nitrate Contaminated Water." *Am. J. Pub. Health* 41:988-996].

The proposed standard is somewhat more stringent than the current MCL of 10 mg/l because it includes an MCL for nitrite (the more toxic form) and a joint standard of 10 mg/l for nitrate and nitrite. Since both nitrate and nitrite result in met Hb, toxicity of nitrate and nitrite may be additive. EPA proposed the joint nitrate/nitrite standard in order to account for the possible additive toxicity of these two chemicals and also to protect against the deterioration of drinking water quality, since the presence of nitrite in water is indicative of water contaminated with sewage.

In the proposal, EPA specifically requested comments on the following issues: (1) The potential cancer risk through drinking water exposure, (2) potential developmental effects and whether the proposed MCLG provides adequate protection against such effects, and (3) whether a lower MCLG would be more appropriate.

(1) Nitrate and Cancer

One commenter stated that there is no definitive evidence from animal bioassay studies that nitrate itself causes excess tumors and, further, the various epidemiological studies that link nitrate and/or nitrite to cancer are not conclusive. Another commenter argued that (a) the Gilli et al. (1984) epidemiology study [Gilli et al., Concentrations of Nitrates in Drinking Water and Incidence of Gastric Carcinomas: First Descriptive Study of the Piemonte Region, Italy, *Science of the Total Env.*, V. 34, pp. 35-48, 1984] provides evidence that nitrate in drinking water is oncogenic (i.e., increased incidence of gastric carcinomas) and (b) Forman et al. (1985) and Al-Dabbagh et al. (1986) are inadequate to conclude whether nitrate and nitrite are carcinogenic. [Both Forman et al. (1985) and Al-Dabbagh et

al. (1986) were discussed in the 1989 proposal (54 FR 22062).] Another commenter noted that the 1989 proposal referenced a number of epidemiologic studies (e.g., Burch et al., 1987) that show an association between cancer and nitrate. Finally, another commenter stated that several epidemiologic studies show an association between *preformed* N-nitroso compounds and cancer.

EPA Response. EPA has reviewed the data submitted by the public as well as significant other data (see Drinking Water Criteria Document for Nitrate and Nitrite, 1990). At this time, EPA is not convinced that nitrate and/or nitrite in drinking water presents a potential risk of cancer. EPA does not believe that data concerning the possible oncogenicity of nitrate and/or nitrite can be entirely dismissed, however.

In attempting to resolve this issue, it is desirable to directly seek the assistance of other Federal agencies concerned with other sources of nitrate. Thus, EPA intends to form an inter-agency work group to determine what, if any, oncogenic risks exist.

(2) Other Effects

Prior to the May 1989 proposal, the Agency reviewed the possible health effects associated with nitrate and nitrite. EPA concluded that (a) infants are the most sensitive subpopulation, (b) methemoglobinemia is the most sensitive toxic endpoint in infants, and, (c) a level of 10 mg of nitrate and, separately, a level of 1 mg of nitrite (both as N) will protect infants

(Note: the calculated RfD is based on this conclusion).

Since the 1989 proposal, the Agency has reexamined the RfD for nitrate considering new data. This review reaffirmed the original conclusion that 10 mg nitrate per liter would protect infants.

In reaching this conclusion the Agency examined a large number of papers concerning the toxicity of nitrate and nitrite. These papers separately dealt with chronic toxicity, developmental and reproductive toxicity, and methemoglobinemia (among other endpoints). Data concerning both humans and experimental animals were reviewed.

EPA has reviewed the data on developmental and reproductive toxicity. Based on that review, EPA believes the data are inadequate to conclude that nitrate and nitrite present a risk of developmental or reproductive effects at the MCLGs.

In addition, the Agency reviewed all public comments as well. The issues

raised by the public are substantially similar to those examined by EPA.

Based on a review of the data, EPA has concluded that an MCLG of 10 and 1 mg/l, respectively, are adequate to protect infants, and all other groups, against the nononcogenic effects presented by nitrate and nitrite in drinking water.

(3) Other Issues

Other commenters recommended that EPA (a) adopt the MCLGs proposed in 1989 for nitrate and nitrite but not adopt the proposed MCLG for the sum of nitrate and nitrite, as it is unnecessary; (b) adopt the MCLGs proposed in 1989 for nitrate and the sum of nitrate and nitrite but not adopt the MCLG proposed for nitrite, as it is unnecessary; (c) only adopt the MCLG proposed for nitrate, as the other two MCLGs are unnecessary; and (d) adopt the proposed MCLGs for nitrate and nitrite but increase the proposed MCLG for the sum of nitrate and nitrite from 10 mg/l to 11 mg/l (both as N).

EPA disagrees with recommendations (a) through (d), above, for the following reasons:

- It is clear that nitrite may occur in drinking water and also that nitrite is toxic, thus a nitrite standard is needed.

- As nitrate is toxic because it is metabolized in the human body to nitrite, it is reasonable to conclude that the toxicity of nitrate and nitrite is additive. Thus, in agreement with the recommendations of the SAB, a combined standard for nitrate and nitrite is warranted.

- Adoption of an 11 mg/l (as N) combined standard for the sum of nitrate and nitrite, in effect, would mean that a combined standard was unnecessary. For the reasons previously stated, EPA disagrees.

Based on the previous discussion, EPA has placed nitrate and nitrite in Category III and promulgates the MCLGs for nitrate, nitrite, and the sum of nitrate and nitrite at 10 mg/l, 1 mg/l, and 10 mg/l (as N), respectively.

f. Selenium. In the 1989 reproposal (54 FR 22062), EPA proposed an MCLG of 0.05 mg/l for selenium and specifically requested comment as to whether an MCLG of 0.02 or 0.1 mg/l might not be more appropriate. The basis of the current proposal is discussed below.

Public Comment. EPA previously addressed the public comments received in response to the previous proposal of November 13, 1985 in the *Federal Register* Notice of May 22, 1989.

(A) The majority of commenters supported an MCLG of 0.1 mg/l. With one exception, no significant additional

data were provided. However, one commenter recommended that, based on a 1989 study by Yang et al. [Yang et al., *Studies of Safe Maximal Daily Dietary Se-Intake in a Seleniferous Area in China*, J. Trace Elem. Electrolytes Health Dis., part III, Vol. 3, pp. 123-130, 1989], EPA should consider a lower MCLG value. In addition, the same commenter observed that a number of individuals take selenium supplements (i.e., selenium is an essential trace element) and thus exposure may be significantly greater than EPA anticipates.

EPA Response. The 0.05 mg/l value proposed in 1989 is based on a human effect level observed by the same author (Yang et al., 1983). EPA normally prefers to base MCLGs on no-effect levels, which are more conservative than human effect levels. However, at the time of the 1989 proposal, an appropriate no-effect level was not available. However, Yang et al. (1989) provides a no-effect level obtained from a human study in China and suggests that 0.400 mg of selenium/person/day is a maximal daily safe intake of selenium.

Assuming the consumption of 2 liters of water/adult/day, consumption of water containing selenium at the proposed 0.05 mg/l MCLG would result in the ingestion of 0.1 mg selenium/person/day. As previously stated (54 FR 22062), the average daily dietary intake in this country is 0.125 mg selenium/person/day. Thus, the combined ingestion of water containing 0.05 mg/l and a typical U.S. diet would result in a total daily exposure of 0.225 mg selenium/person, a value well below the 0.400 mg selenium that Yang et al. suggests is safe. Consequently, EPA has concluded that Yang et al. (1989) supports the proposed MCLG of 0.05 mg/l.

EPA believes that the difference (i.e., 0.175 mg selenium/person/day) between dietary intake (0.225 mg selenium/person/day) and the maximal daily safe intake of selenium (0.4 mg selenium/person/day) recommended by Yang et al. (1989) is adequate to protect those who may take selenium supplements. Thus, EPA believes that the 0.05 mg/l value is adequate to protect both the general public and those who may take selenium supplements.

(B) Although providing no new data, other commenters recommended an MCLG of 0.1 mg/l or higher.

EPA Response. EPA disagrees with these comments for the following reasons: (1) It is likely that there are individuals who, whether due to diet or supplements consume significantly more selenium than the 0.125 mg selenium/person/day that EPA has estimated that the average citizen

consumes, and (2) EPA believes that an MCLG higher than 0.05 mg/l may not adequately protect those who chronically consume such elevated amounts of selenium. Thus, EPA has rejected those comments that argue for an MCLG of 0.1 mg/l or more.

After reviewing the public comments, EPA has concluded that selenium should be placed in Category III and an MCLG of 0.05 mg/l is promulgated.

5. Volatile Organic Contaminants (VOCs) MCLGs

a. cis-1,2-Dichloroethylene and trans-1,2-Dichloroethylene. EPA proposed an MCLG of 0.07 mg/l based on a 3-month study in rats using cis-1,2-dichloroethylene. From that study, a DWEL of 0.4 mg/l (rounded from 0.35 mg/l) was calculated and a 20 percent drinking water contribution was assumed. For trans-1,2-dichloroethylene, EPA proposed an MCLG of 0.1 mg/l based on compound-specific data. A DWEL of 0.6 mg/l was derived and a drinking water contribution of 20 percent was assumed to determine the MCLG.

Public Comments and EPA Response. EPA previously addressed the public comments received in response to the earlier proposal of November 13, 1985 in the Federal Register Notice of May 22, 1989. With respect to the cis isomer, one commenter stated that data on 1,1-dichloroethylene should not be used for the cis compound, because there is no evidence that the effects of the two compounds are similar. Another commenter stated that the MCLG for cis-1,2-dichloroethylene should be based on Freundt and Macholz (Toxicology 10:131-139, 1978). Another commenter stated that the NTP two-year bioassay for 1,1-dichloroethylene was a better study for deriving a NOAEL/LOAEL for determining MCLGs/MCLs.

For the trans isomer, one commenter stated that their MCL was lower than EPA's MCL. However, they need to review the Barnes et al. (Drug Chem. Toxicol. 8:373-392, 1985) manuscript prior to revising their MCL.

Another commenter disagreed with the selection of NOAEL/LOAEL from the Barnes et al. study and stated that, based on the increase in glucose levels and decrease in aniline hydroxylase activity, 17 mg/kg/day should be a LOAEL and not a NOAEL.

The final MCLG for cis-1,2-dichloroethylene is based on a 3-month compound-specific study by McCauley et al. The Agency's RfD Workgroup has reviewed the data and verified a RfD of 0.01 mg/kg/day.

There are several reasons that the Agency is not using the Freundt and

Macholz (1978) study to set an MCLG. First, it is a single eight-hour exposure. EPA does not generally use single exposure studies to set lifetime numbers. Second, it is an inhalation exposure and the Agency prefers to use route-specific (oral) data if possible. Third, the selection of an adverse effect in the Freundt and Macholz (1978) study is questionable. A decrease in microsomal metabolism (i.e., aniline hydroxylase), while an obvious effect, is not necessarily an adverse effect. In fact, if a chemical is activated to a toxic metabolite, inhibition of that chemical's metabolism might be beneficial. Fourth, and most important, the Agency presently has an oral three-month study on cis-1,2-dichloroethylene.

The Agency did not select the NTP two-year bioassay because they gave the 1,1-dichloroethylene in corn oil and oil vehicles have been reported to potentiate the adverse effects of 1,1-dichloroethylene (Chieco et al., Toxicol. Appl. Pharmacol. 57:148-155, 1981).

Since the new trans-1,2-dichloroethylene data are going to be reviewed by the commenter, no Agency reply is necessary at this time. With respect to selection of a NOAEL/LOAEL in the Barnes et al. (1985) study, the RfD workgroup did review the data very carefully. Tables 11 and 12 of the Barnes et al. (1985) paper do report that there are significant increases in serum glucose levels in both male and female CD-1 mice. However, even though the difference between the low- and high-dose levels administered to the mice is 20 fold, there are no differences in serum glucose levels at these two doses. This calls into question the toxicological significance of the increased glucose levels. In addition, the Agency does not know the normal range for variation in serum glucose for this strain. The Agency's RfD workgroup did not believe that either the increased serum glucose levels or the decreased aniline hydroxylase levels (also see discussion for cis-1,2-dichloroethylene) were adverse effects. Accordingly, the 17 mg/kg/day treatment level was used as a NOAEL. EPA has placed cis-1,2-dichloroethylene and trans-1,2-dichloroethylene in Category III and the respective MCLGs of 0.07 and 0.1 mg/l will be retained.

b. 1,2-Dichloropropane. EPA proposed an MCLG of zero for 1,2-dichloropropane based on the statistically significant increased incidence of hepatocellular neoplasms and primary adenomas in male and female B6C3F₁ mice. The frequency of liver carcinomas alone was not significant for males or females, but

there was an increase in tumors in both sexes. Also, there was a dose-related trend in mammary adenocarcinomas in female F344 rats. The increased adenocarcinoma incidence in the female rats was considered to be significant since the F344 rat has a relatively low background occurrence rate for these tumors. Therefore, EPA classified 1,2-dichloropropane in Group B2.

Public Comments. Three individuals or organizations provided comments in response to the MCLG proposal regarding 1,2-dichloropropane. One commenter was in agreement with EPA's proposed classification of 1,2-dichloropropane into Group B2, and with EPA's proposed establishment of an MCLG at zero. Two commenters stated that a problem might exist with the NTP study of B6C3F₁ mice in terms of showing a high incidence of tumors in the control mice compared to the mice which received the high dose of this chemical. They suggest a reevaluation of this study before establishing an MCLG.

EPA Response. The EPA's classification of 1,2-dichloropropane in Group B2 was based on the results of the final NTP report. This report was peer reviewed and audited by the Peer Review Panel and Audit Workgroup, respectively, and was found acceptable in terms of results reported in the final NTP report. EPA concludes that a reevaluation of this study would not change the findings of this report. Consequently, EPA has placed 1,2-dichloropropane in Category I and an MCLG of zero is promulgated.

c. Ethylbenzene. EPA proposed an MCLG of 0.7 mg/l for ethylbenzene. The MCLG was derived from a DWEL of 3.4 mg/l, by applying a 20 percent drinking water contribution and rounding off to one significant number.

Public Comments. EPA previously addressed the public comments received in response to the earlier proposal of November 13, 1985 in the *Federal Register* Notice of May 22, 1989. In response to the 1989 *Federal Register* Notice, one commenter agreed with the choice of study, NOAEL, and LOAEL, but questioned the use of a 10-fold uncertainty factor to convert from subchronic to chronic exposure. The commenter explained this position in the following manner: Since the adverse effects of doses 3- or 5-fold higher than the NOAEL were minor and a 2-year NTP study on mixed xylenes, which contained 17 percent ethylbenzene equivalent to 85 mg of ethylbenzene/kg/day, showed no adverse effects, the extra 10-fold uncertainty factor could be omitted.

EPA Response. EPA believes that the 10-fold uncertainty factor for converting

a subchronic to a chronic study is still necessary for several reasons. In the Wolf et al. study (*Arch. Ind. Hlth* 14:387-398, 1956), the NOAEL of 136 mg/kg was adjusted by 5/7 since the animals were treated for only 5 days/week. Some recovery from the effects of ethylbenzene could have occurred during the two days of non-treatment. The administration of 85 mg of ethylbenzene/kg/day as part of an assay of mixed xylenes does not necessarily mean that a 85 mg ethylbenzene/kg/day dose is without effect since EPA does not know about potential interactions among the compounds. In addition, the finding of minor adverse effects at doses 3- and 5-fold higher than the NOAEL does not exclude the possibility that extended exposure at lower doses would lead to adverse effects. Since there are many unanswered questions on the toxicity of ethylbenzene, EPA feels that the 1,000-fold uncertainty factor, including a 10-fold for subchronic to chronic exposure, is appropriate for this chemical. Consequently, EPA places ethylbenzene in Category III and the MCLG of 0.7 mg/l is promulgated as proposed.

d. Monochlorobenzene. EPA proposed an MCLG of 0.1 mg/l for monochlorobenzene in the May 22, 1989 proposal. The MCLG was derived from a DWEL of 0.7 mg/l, applying a 20 percent contribution from drinking water and, because of reclassification of monochlorobenzene in Group D (inadequate evidence for carcinogenicity) according to the EPA guidelines, no additional uncertainty factor for possible carcinogenicity. This MCLG is a revision of the MCLG of 0.06 mg/l (derived from a DWEL of 3.0 mg/l, applying a 20 percent contribution factor from drinking water and an uncertainty factor of 10 used with agents classified in Group C (possible human carcinogen: for monochlorobenzene, limited evidence in animals based on increased neoplastic nodules in liver of male rats in one bioassay)) previously proposed in November 13, 1985. Revision of the MCLG to change the basis for the DWEL and downgrade the carcinogenicity classification from Group C to Group D (Category II to III) is the result of further review of data and review of the MCLG for monochlorobenzene by the EPA's Science Advisory Board in 1986.

Public Comments. EPA addressed the public comments received in response to the previous proposal of November 13, 1985 in the *Federal Register* Notice of May 22, 1989. Two commenters responded to that *Federal Register* notice. The first commenter supported reclassification of monochlorobenzene from Group C to Group D. The second

commenter felt that the appropriate classification is Group C and that an additional uncertainty factor should be applied to the study used to derive the DWEL to account for limitations in study design.

EPA Response. EPA agrees with the commenter who supports reclassification of monochlorobenzene from Group C to Group D. EPA reclassified monochlorobenzene after concluding that the combination of neoplastic nodules and hepatocellular carcinomas in male rats in the carcinogenicity bioassay was not adequate evidence of a treatment-related effect to, in turn, support limited evidence for carcinogenicity of monochlorobenzene in animals. EPA disagrees with the second commenter that an extra uncertainty factor is needed with the study used as the basis for the DWEL because EPA considers the 1,000-fold uncertainty factor already used with the study as adequate compensation for uncertainty surrounding limitations in the study design. Consequently, as discussed above, EPA places monochlorobenzene in Category III and an MCLG of 0.1 mg/l is promulgated.

e. ortho-Dichlorobenzene. EPA proposed an MCLG of 0.6 mg/l for ortho-dichlorobenzene in the May 22, 1989 proposal. The MCLG was derived from a DWEL of 3.0 mg/l, applying a 20 percent contribution from drinking water.

Public Comment. One commenter felt that because a NOAEL from a chronic (two-year) study in rats was used for calculation of the DWEL, the uncertainty factor should be 100 instead of 1,000 as used by EPA.

EPA Response. EPA disagrees with the comment that the uncertainty factor for the DWEL calculation should be 100 instead of 1,000. Although EPA commonly applies a 100-fold uncertainty factor with a chronic (lifetime) study in rats, EPA chose to use a 1,000-fold uncertainty factor for the DWEL calculation for ortho-dichlorobenzene because toxicity endpoints were assessed in a preliminary subchronic (13-week) study in rats that were not evaluated in the chronic study and because of data gaps (an inadequate reproductive toxicity study in a non-rodent species reproduction study). Consequently, EPA places ortho-dichlorobenzene in Category III and an MCLG of 0.6 mg/l is promulgated as proposed.

f. Styrene. EPA proposed two MCLGs in the May 22, 1989 proposal because EPA had not yet finalized its carcinogenicity classification for

styrene. One MCLG of 0.1 mg/1 was derived from a DWEL of 7 mg/1, applying a 20 percent contribution from drinking water and an additional 10-fold uncertainty factor by considering the classification of styrene to be Group C. The other MCLG was zero, considering the classification of styrene to be Group B2. At meetings on styrene with EPA's Science Advisory Board in 1988 and 1990, EPA favored a classification of Group B2, whereas the SAB opinion favored a classification of Group C. Additionally, at the 1990 meeting with the SAB, the SAB preferred a multigeneration reproduction/chronic toxicity study in rats over the subchronic toxicity study in dogs the EPA had used for calculation of the DWEL.

Public Comments. EPA addressed the public comments received in response to the previous proposal of November 13, 1985 in the Federal Register Notice of May 22, 1989. In response to that Federal Register Notice, six commenters advocated no classification for styrene or, if it is to be classified, classification into Group D. One of these commenters also preferred use of the rat study over the dog study, as described above, for calculation of the MCLG. This commenter felt the MCLG should therefore be 1.6 mg/1 (which EPA would round to 2 mg/1), calculated as a Group D classification, thereby omitting the extra uncertainty factor of 10 required for styrene in Group C. Two commenters supported classification of styrene in Group B2 and promulgation of an MCLG of zero, in the opinion that the data are sufficient to meet the criteria for Group B2. Two commenters felt the proper classification for styrene is Group C and an appropriate MCLG is 0.1 mg/1.

EPA Response. The EPA has not classified styrene as to its carcinogenicity potential at this time. The EPA has presented to the Science Advisory Board arguments to classify styrene in Group B2: probable human carcinogen. The Science Advisory Board responded that the weight of evidence supported a group C classification. Thus, the cancer classification issue is still under review by the Agency.

Via corn oil gavage, there is some evidence that styrene may induce tumors in rodents, and a cancer risk of 9×10^{-7} per $\mu\text{g}/1$ is estimated from the NCI mouse study (NCI, 1979). Available oral studies in rats have not shown carcinogenic activity. In setting an MCLG for styrene in drinking water, EPA has carefully considered the overall weight of evidence of cancer, especially: (1) The comparatively low estimated cancer potency (based on the corn oil

gavage study); (2) the lack of a carcinogenic response in an adequately conducted drinking water study. In addition, styrene is not likely to be widespread in drinking water based on occurrence information currently available in the Agency. Consequently, EPA is placing styrene in Category II and is promulgating an MCLG of 0.1 mg/1 based on the Quast et al. (1978) study in dogs.

g. Tetrachloroethylene. In the May, 1989 notice, EPA proposed an MCLG for tetrachloroethylene (perchloroethylene or PCE) of zero. The Agency has found strong evidence of carcinogenicity from ingestion based on consideration of the weight of evidence, pharmacokinetics and exposure.

The Agency uses a three category approach to set MCLGs under the Safe Drinking Water Act (see 50 FR 46944-46949 (November 13, 1985) and 54 FR 22068 (May 22, 1989)). A chemical for which there is strong evidence of carcinogenicity is placed in Category I. As a matter of policy, EPA sets MCLGs for chemicals in Category I at zero (see earlier discussion of this policy). Recognizing the continuing scientific controversy over the appropriate weight of evidence for the chemical, the Agency also solicited public comment on an MCLG of 0.01 mg/1 which would reflect a possible human carcinogen (Category II). EPA received a number of comments on the proposal and these comments are addressed below.

In separate actions, the Agency is currently deliberating concerning an Agency-wide classification of PCE, according to its normal procedure. On December [28], 1990, EPA issued a notice for publication in the Federal Register that described the process the Agency is following to bring these deliberations to a conclusion. (A Federal Register citation for that notice was not available on the date of signature of today's notice; however, the title of the notice is "Amendment to Preambles Published at 54 FR 33418 (August 14, 1989) and 54 FR 50968 (December 11, 1989)").

While these deliberations continue, EPA must take final action on an MCLG and NPDR for tetrachloroethylene. This chemical is included on the list of 83 chemicals that Congress specifically directed EPA to regulate. The Agency is under court order to promulgate regulations for this contaminant by December 31, 1990. Accordingly, EPA today is promulgating an MCLG for PCE in accordance with the three-category approach developed to implement the SDWA. This action does not reflect a final Agency decision on PCE's

classification; it represents a separate and distinct regulatory evaluation and risk management decision concerning PCE. When the Agency completes its deliberations regarding classification, we may reconsider the MCLG for tetrachloroethylene, as appropriate.

Based on EPA's careful review of the comments received in response to the May, 1989 notice and the Agency's evaluation of scientific evidence available since the proposal, it remains EPA's view that there is strong evidence of carcinogenicity through ingestion and that PCE is a Category I chemical for purposes of establishing an MCLG under the SDWA.

Public Comments. The pivotal comments dealt with EPA's categorization of tetrachloroethylene as a probable or possible human carcinogen for purposes of setting an MCLG under the SDWA. One commenter argued that: (1) Tetrachloroethylene metabolites/trichloroacetic acid, which are carcinogenic, were tested in a sensitive strain of mice having a high background liver tumor incidence, (2) mononuclear cell leukemia observed in animals may not be relevant to man, and (3) renal tumors observed in male F-344 rats are species-specific. One commenter argued that this contaminant is a probable human carcinogen; another supported classification of PCE as a possible human carcinogen.

EPA Response. Based on the available carcinogenicity evidence from experimental animal studies and the high frequency of occurrence in drinking water, EPA continues to view PCE as a Category I contaminant for drinking water regulation. The evidence for carcinogenic hazard has two parts, i.e., epidemiologic data and animal data as supplemented by metabolism information and results from short-term studies. In 1985 EPA viewed the epidemiologic data as inadequate to refute or demonstrate a human health hazard potential. EPA is aware of two more recent studies which discuss increased cancer mortality among dry cleaner workers. These studies have not yet been comprehensively integrated into the epidemiologic assessment for PCE. It is not apparent, however, that the influence of PCE alone can be delineated since multiple solvents are involved in one study and in the other study in which PCE is the primary solvent, while the findings are nonpositive, the exposed group was too small to be useful in risk assessment. In experimental animals, three types of tumors in rodents contribute to the inference for a cancer causing potential

in humans. Indications of cancer activity were seen in mice and rats, in both sexes, by inhalation and oral exposure. Short-term studies and other information about PCE metabolism and toxicity of the metabolites both contribute to the hazard concern as well as provide some basis for hypothesizing about tumor formation and relevancy for human hazard assessment.

While there is some uncertainty about the relevance to humans of the animal tumor endpoints, the totality of the animal evidence is judged by EPA to be sufficient to view PCE as a Category I contaminant. The lack of key information does not support the use of the uncertainties to discount the sufficient level of animal evidence. EPA's response to a number of issues raised in the public comments are summarized below.

(1) *Mouse Liver Tumor.* The controversy surrounding the liver tumor response in the B6C3F1 male mouse is well recognized, and EPA is aware of the divergent scientific views regarding the use of this animal endpoint in carcinogen risk assessment. The Agency undertook extensive review of this issue while it was developing the carcinogen risk assessment guidelines and in 1987 solicited PCE-related advice from the SAB. The Agency's position is that mouse liver tumors are considered evidence for potential human carcinogenicity. The guidelines take the position that the mouse liver tumor response, when other conditions for classification of "sufficient" evidence in the animals are met (e.g., replicate studies of malignancy, tumors at multiple sites, etc.) should be considered as "sufficient" evidence of carcinogenicity on a case by case basis. In the March, 1988 letter reviewing tetrachloroethylene issues, the EPA Science Advisory Board concurred with the Agency's criteria for evaluating mouse liver tumor responses.

(2) *Peroxisome Proliferation.* In the case of PCE, peroxisome proliferation has been proposed as a plausible mechanism for mouse liver tumor development. Although PCE and metabolite trichloroacetic acid (TCA) induce peroxisome proliferation and tumors in the mouse liver, a cause and effect relationship is not, thereby, defined. While peroxisome proliferation may have a role in mouse liver tumor formation, the role is undefined. Other plausible mechanistic hypotheses exist including those associated with genotoxicity. There may be multiple mechanisms involved in mouse liver tumor formation. At the present time, EPA maintains the view that mouse liver

tumors are relevant for inferring a potential for human health hazard unless there is more definitive evidence to the contrary.

(3) *Mononuclear Cell Leukemia.* Mononuclear cell leukemia, a neoplasm that has been characterized biologically and pathologically, was seen in both male and female rats exposed to PCE. Overall leukemia rates were statistically significant in the males and marginally so in females. When stage 3 leukemias were counted, positive trends and significant increases in male and female rats were seen.

PCE caused a dose-related increase in severity of mononuclear leukemia and shortened the time-to-tumor in female rats. One commenter questioned the relevance of this tumor to humans. EPA does not consider it appropriate to rule out a rodent neoplasm simply because it has no exact human counterpart. Site concordance is not a requirement for relevancy in the inference of hazard potential.

Although a statistically significant increase in tumor incidence for a tumor having a high concurrent background tumor incidence is consistent with theory of promotion, this observation does not identify the actual mechanism, and thus several other plausible mechanistic theories of PCE-induced leukemia development can not be ruled out.

A statistically significant increase in tumor incidence cannot be arbitrarily dismissed without firm evidence showing that mononuclear cell leukemia in rats is a type of tumor response isolated to this species and not relevant to other potential tumor endpoints in other species. Rather, EPA assumes that the experimental animal evidence identifies the potential for a carcinogenic response in humans unless there is evidence to the contrary.

(4) *Male Rat Kidney Tumor.* PCE increases the occurrence of an uncommon renal tubular cell tumor in male rats. Recent research and conventional toxicological thinking have suggested at least three plausible explanations for the tumor occurrence, i.e., the presence of a unique male rat renal protein, alpha-2u-globulin; presence of a secondary metabolic pathway which produces a genotoxic compound in the kidney; and chronic nephrotoxicity and cellular regeneration independent of the alpha-2u-globulin. The EPA is presently developing criteria which will define a weight-of-evidence approach for evaluating, on a case by case basis, the role of alpha-2u-globulin in rat kidney tumor formation. For instance, if the PCE data are

subsequently judged to be the only definitive explanation for the occurrence of male rat kidney tumors, this tumor endpoint may have minimal relevance for human health hazard assessment. This can be further evaluated by EPA as criteria and PCE-specific data become available.

Given the presence of other plausible mechanistic explanations, and the currently incomplete picture about the role of the PCE-rat kidney protein, EPA views the rat kidney tumor endpoint to be indicative of PCE exposure and relevant for consideration in the overall weight of evidence for potential PCE human health hazards.

Consequently, based on the information available to the Agency and the public comments received on the May, 1989 proposal, EPA for the reasons cited above continues to place tetrachloroethylene in Category I and promulgates an MCLG of zero.

b. Toluene.

EPA proposed an MCLG of 2.0 mg/l for toluene in the November 1985 proposal and again in the May 1989 proposal based on a NOAEL of 1,130 mg/m³ from an animal study.

Public Comments. Two commenters submitted information in response to EPA's proposal for regulation of toluene. The major health effect issues raised are (1) use of rat ventilatory volume and body weight in calculating the rat total absorbed dose instead of human ventilatory volume and body weight, and (2) use of a recently available 13-week National Toxicology Program (NTP) oral administration study rather than the inhalation study used by EPA.

EPA Response. EPA agrees with the commenter that the rat ventilatory volume and body weight, instead of that of humans, be used for the calculation of total absorbed dose. EPA also agrees with the suggestion by the commenter that the NTP 1989 oral administration study is acceptable for the derivation of the MCLG, because it is preferable to use valid oral studies, if available, for the calculation of the MCLG.

In the NTP study, groups of rats were administered toluene in corn oil at dosage levels of 0, 312, 625, 1,250, 2,500, or 5,000 mg/kg for five days/week for 13 weeks. Liver-to-brain ratio was increased ($p < 0.05$) in males receiving the 625-mg/kg dose. This study established a NOAEL of 312 mg/kg, adjusted to 223 mg/kg/day for exposure of five days per week. From this dose, an RfD of 0.2 mg/kg/day and a DWEL of 7 mg/l were determined.

Calculations using the NTP study result in the MCLG for toluene decreasing from 2 mg/l (the proposed

value) to 1 mg/l. Therefore, for the reasons stated above, EPA places toluene in Category III and promulgates an MCLG of 1 mg/l.

i. Xylenes. EPA proposed an MCLG of 10 mg/l (rounded from 12 mg/l) for xylenes. EPA's proposal of 10 mg/l was based on the NTP study involving the administration of 0, 250, or 500 mg/kg xylenes in corn oil by gavage to groups of rats of each sex for 103 weeks.

Public Comments. A total of six individuals or organizations provided comments in response to the MCLG proposal regarding xylenes. Three commenters felt that EPA should not round the proposed MCLG for xylenes down from 12 mg/l to 10 mg/l. One commenter felt that given the uncertainty of the data presented in the NTP study and the lack of clear difference between the administered dosages, EPA should have considered the low dosage (250 mg/kg) in the NTP study as the LOAEL rather than the NOAEL. Another commenter stated that the NTP study of rats given xylenes in corn oil by gavage for 103 weeks was not an appropriate study for the MCLG for xylenes and suggested a teratogenic study in animals instead.

EPA Response. EPA believes the rounded figure was appropriate because using more than one significant figure would have implied a degree of precision that was not warranted given the large uncertainty factor (100) that was used in deriving the MCLG. EPA considered the low dosage of 250 mg/kg from the NTP study in rats as the NOAEL since the mean body weights of low-dose and vehicle control male rats and those of dosed and vehicle control female rats were comparable. EPA also considered that the NTP oral study in animals was more representative of xylene's toxicity in drinking water than was the inhalation teratogenic study (Mirkova et al., 1983) suggested by the commenter. The NTP oral study in animals entailed 103 weeks of exposure to xylenes as compared to only 21 days of exposure to xylenes via inhalation. Available cancer information on xylenes has been reviewed by EPA and was found to be inadequate for determining potential carcinogenicity in humans.

For these reasons, EPA places xylenes in Category III and promulgates an MCLG of 10 mg/l.

6. Pesticides/PCBs MCLGs

a. Alachlor. EPA proposed an MCLG of zero for alachlor in the May 22, 1989 proposal. The MCLG was based on sufficient evidence of carcinogenicity in animals (classification of Group B2 by EPA guidelines: Probable human carcinogen) in the November 13, 1985

Federal Register Notice. No new data that change the conclusions presented in that notice have become available since its publication.

Public Comments. EPA addressed the public comments received to the previous proposal of November 13, 1985 in the Federal Register Notice of May 22, 1989. In response to this 1989 notice, one commenter on the MCLG for alachlor indicated that EPA should consider establishing a value other than zero as the MCLG for B2 carcinogens. The commenter indicated that although the Agency classified alachlor in Group B2, this chemical is unlikely to cause cancer in people under usual conditions of exposure. The commenter urged the Agency to consider the modification of its "standard" approach in quantitative risk assessment in the case of alachlor and use the weight-to-weight extrapolation instead of "surface area correction" to extrapolate risk from animal to human.

EPA Response. EPA believes there is sufficient data to conclude that alachlor is carcinogenic in animals since the compound was shown to be carcinogenic in both rats and mice. EPA therefore has classified alachlor in Group B2: Probable human carcinogen. EPA's policy in the calculation of the quantitative risks for carcinogens is based on the weight-to-surface extrapolation from animal to human data (U.S. EPA Cancer Guidelines, 1986). Accordingly, EPA places alachlor in Category I and an MCLG of zero is promulgated.

b. Atrazine. EPA did not propose an MCLG for atrazine in the November 13, 1985 Federal Register Notice due to limited toxicological data on the chemical at that time. However, since then, sufficient new data became available to EPA to propose an MCLG for atrazine in May 1989.

Accordingly, EPA proposed an MCLG of 0.003 mg/l for atrazine in the May 22, 1989 proposal. The MCLG was derived from a DWEL of 0.2 mg/l, applying a 20 percent contribution from drinking water and an additional 10-fold uncertainty factor by classifying atrazine in Group C.

The proposed MCLG was based upon non-carcinogenic effects in a one-year dog feeding study (Ciba-Geigy, 1987, No. 852008 and Pathology Report No. 7048, MRID 40313-01). A NOAEL of 0.5 mg/kg/day was identified based upon the finding of discrete myocardial degeneration at the highest dose level (43 mg/kg/day) and findings at the 5.0 mg/kg/day dose level that suggested a trend toward the development of the cardiac pathology seen at the higher dose.

After the May proposal, a detailed analysis of these cardiac effects identified by Ciba-Geigy in 1989 (MRID 412938-01) was reviewed by the Agency. The review resulted in EPA increasing the NOAEL from 0.5 mg/kg/day to 5.0 mg/kg/day. Subsequently, the existing study supporting the dog study, the two-generation reproduction study in rats with a NOAEL of 0.5 mg/kg/day and a LOAEL of 2.5 mg/kg/day (Ciba Geigy, 1987, MRID 404313-03), became the basis for the RfD, DWEL, and MCLG calculations. Consequently, the RfD for atrazine remains the same at 0.005 mg/kg/day (based on the use of a NOAEL of 0.5 mg/kg/day and a 100-fold uncertainty factor). Both the DWEL and MCLG remain unchanged at 0.2 mg/l and 0.003 mg/l, respectively.

In this two-generation study, atrazine was mixed in the diet at 0, 10, 50, and 500 ppm (equivalent to 0, 0.5, 2.5, and 25 mg/kg/day). Pup weights at postnatal day 21 were statistically significantly reduced at the two higher doses, 2.5 and 25 mg/kg/day, in the second generation. The NOAEL in this study is also supported by adverse findings at dose levels higher than 0.5 mg/kg/day in both the rat chronic feeding/oncogenic study by Ciba-Geigy (1986, Study #401-1102, Accession No. 26714-262727) and the two-year feeding study in dogs by Woodard Research Corporation (1984, MRID 0059213).

Public Comments. Four individuals or organizations commented on the MCLG and MCL proposal for atrazine. Two commenters agreed with EPA on the proposed MCLG and MCL; however, one of these two commenters indicated that when new data become available to the Agency, the proposal should include an update of the MCLG and MCL values based on this new information. This commenter also indicated that the Agency's citation of adverse effects on liver and kidney of dogs and rats at high levels as the basis for setting the MCL at 3 ppb is inconsistent with the statement on page 22061 of the May 22, 1989 Federal Register Notice which says the absence of cardiac lesions in dogs at a dose of 0.48 mg/kg/day provided the basis for the MCL. The commenter noted that since these effects occurred at high levels only, they are not the primary effect of atrazine; therefore, the statement on page 22061 should be corrected to reflect the effects noted at the lowest effect level. The third commenter was concerned with the selection of the NOAEL for the calculation of the DWEL; he indicated that the Agency should use the higher NOAEL of 0.5 mg/kg/day in the rat study instead of the lower NOAEL of

0.35 mg/kg/day in the two-year dog study to calculate the MCLG for atrazine. The fourth commenter indicated that atrazine should be classified in Group B2 instead of C because, in his opinion, the rat study provided "sufficient evidence" of carcinogenicity; therefore, the MCLG should be zero. In addition, he argued that the Agency's rationale for classifying atrazine in Group C (see 54 FR 22062 at 22082) is misleading and should have read: "Limited evidence of carcinogenicity, which means that the data suggest a carcinogenic effect but are limited because (a) the studies involve a single species, strain, or experiment and do not meet criteria for sufficient evidence (see Section IV B 1 c);" (52 FR 33999, emphasis added)."

EPA Response. New information became available to the Agency on the 1987 one-year dog study (Ciba-Geigy, MRID 40313-01) that was used in the calculation of the RfD and DWEL. This new information (Ciba-Geigy, 1989, MRID 412938-01) caused the NOAEL in this study to change from 0.5 mg/kg/day to 5.0 mg/kg/day. Since the Agency usually uses the highest NOAEL in the most sensitive species to calculate the RfD, the two-generation rat study discussed above with a NOAEL of 0.5 mg/kg/day (Ciba-Geigy, 1987, MRID 404313-03) was selected as the most appropriate study to determine the RfD. Since the new RfD is the same in value as the previous RfD, which was calculated from the one-year dog study in the May 22, 1989 proposal, the DWEL and MCLG will remain as proposed at 0.2 and 0.003 mg/l, respectively.

In response to the comment that atrazine should be classified in Group B2, the Agency disagrees based on the fact that the increased incidence of the mammary tumors (a tumor with a generally high spontaneous background in the rat) was noted only in one species and one strain of rat.

Accordingly, EPA places atrazine in Category II and promulgates an MCLG of 0.003 mg/l for atrazine, as proposed in the May 1989 proposal based on the changed basis for the RfD, as discussed above.

c. Carbofuran. EPA proposed an MCLG of 0.04 mg/l for carbofuran in the May 22, 1989 proposal. The MCLG was derived from a DWEL of 0.2 mg/l, applying a 20 percent contribution from drinking water. Carbofuran is classified in Group E (no evidence of carcinogenicity) by EPA. The MCLG of 0.04 mg/l in the November 13, 1985 proposal was rounded in the May 1989 proposal to 0.04 mg/l. No new data that would change the conclusions presented

in that notice have become available since its publication.

Public Comment. EPA previously addressed the public comments received in response to the previous proposal of November 13, 1985 in the Federal Register notice of May 22, 1989. In response to this notice of 1989, three individuals or organizations commented on the MCLG proposal for carbofuran. One commenter indicated that the proposed standard does not protect from immune system depression in humans. Another commenter indicated that additional negative immunological studies were not discussed in the carbofuran criteria document, in addition, this commenter provided corrections and editings to the chemistry, occurrence and fate sections of the criteria document. A third commenter requested a change in the NOAEL used in the calculation of the RfD from 0.5 to 0.25 based on cholinesterase activity, thus indicating that the MCLGs should be two-fold lower.

EPA Response. EPA addressed the issue of cholinesterase inhibition as the endpoint of toxicity in a special forum. The 15 to 20 percent inhibition in blood cholinesterase activity may be considered a LOAEL. This level of inhibition may be considered adverse or non-adverse on a case-by-case basis depending on the toxicological profile of the chemical. In the case of carbofuran, the NOAEL is based on the effects noted on both the reproductive and nervous systems. The chosen NOAEL of 0.5 mg/kg/day was the appropriate NOAEL for both systems; the uncertainty factor applied to this NOAEL is 100-fold, resulting in an MCLG of 0.04 mg/l. If the lower dosage of 0.25 mg/kg/day was selected as the basis of these calculations, the applied uncertainty factor (UF) would have been 10-fold only because a larger UF would not be justified based on the available toxicity profile of carbofuran. Therefore, the MCLG would have been higher than 0.04 mg/l, not two-fold lower. The choice of the NOAEL of 0.5 mg/kg/day in the dog study and the application of a 100-fold UF were more protective to public health because the NOAEL was based on both endpoints of toxicity, testicular effects and blood cholinesterase inhibition, with an appropriate selection of the UF as necessitated by the severity of these endpoints.

In response to the commenters on immunotoxicity, EPA believes further research in this area is needed before any conclusion can be made on the effect of carbofuran on this endpoint. Consequently, EPA places carbofuran in

Category III and an MCLG of 0.04 mg/l is promulgated.

d. Chlordane. EPA proposed an MCLG of zero for chlordane based on sufficient evidence of carcinogenicity in animals (Group B2). While the proposed MCLG of zero is based on the carcinogenicity of chlordane, EPA provided a revised DWEL of 0.002 mg/l based on the results of a newer chronic rat dietary study (Yonemura et al., 1983; 30-month chronic toxicity and tumorigenicity test in rats by chlordane). This DWEL was calculated assuming an uncertainty factor of 1,000 (100 for the inter- and intraspecies differences and 10 for the lack of a second chronic toxicity/reproductive study) and consumption of 2 liters of water per day by a 70-kg adult.

Public Comment. One commenter stated that (1) chlordane was not properly considered a "B2" carcinogen since the EPA Carcinogen Assessment Group (CAG) report (1986) could not justify such a classification; therefore the basis for a proposed MCLG of zero was incorrect, and (2) EPA incorrectly used an additional safety factor of 10 because of a lack of a second chronic study in the derivation of the DWEL for chlordane.

EPA Response. According to EPA's guidelines, a Group B2 classification (probable human carcinogen) is used when there is sufficient evidence of carcinogenicity in animals and inadequate data in humans. EPA considers that chlordane is correctly proposed as a Group B2 carcinogen because a number of rodent studies (with four strains of mice of both genders and F344 male rats) had clearly demonstrated the induction of liver tumors in animals following administration of chlordane. In addition, three compounds structurally related to chlordane, aldrin, dieldrin, and chlorendic acid have produced liver tumors in mice. Chlorendic acid has also produced liver tumors in rats.

EPA has correctly applied an additional safety factor of 10 in the derivation of the DWEL due to the lack of a second chronic study in animals. EPA believes that the lack of adequate chronic toxicity data and the lack of data on reproductive effects require an additional factor of 10. Therefore, EPA places chlordane in Category I and an MCLG of zero is promulgated based on sufficient evidence of carcinogenicity in animals and inadequate data in humans.

e. 1,2-Dibromo-3-chloropropane (DBCP). EPA proposed an MCLG of zero for 1,2-dibromo-3-chloropropane in the May 22, 1989 proposal. The MCLG was based on sufficient evidence of

carcinogenicity in animals (classification in Group B2 by EPA guidelines: Probable human carcinogen) in the November 13, 1985 Federal Register notice. No new data which change the conclusions presented in that notice have become available since its publication.

Public Comments. EPA addressed the public comments received in response to the previous proposal of November 13, 1985 in the Federal Register Notice of May 22, 1989. One commenter stated that there is valid epidemiological evidence to show that 1,2-dibromo-3-chloropropane is not a human carcinogen and that animal studies unreliably predict carcinogenicity. Consequently, this commenter concludes overall evidence adequately supports downgrading 1,2-dibromo-3-chloropropane from Group B2 to Group C by the EPA guidelines. If this is done, the commenter recommends setting the MCLG on the basis of non-carcinogenic toxic effects with an adequate margin of safety. The commenter states that if EPA continues the Group B2 classification for 1,2-dibromo-3-chloropropane, then the MCLG should be set at a level corresponding to a lifetime cancer risk of 10^{-4} to 10^{-5} or on the basis of noncarcinogenic toxic effects with an added margin of safety. Using EPA's risk assessment, the commenter concludes that an increased cancer risk in the range of 10^{-4} to 10^{-5} would be at least 0.001 mg/l (corresponding to a risk of 4×10^{-5}); therefore, the commenter feels the MCLG should be set at 0.001 mg/l or greater. The commenter believes EPA's proposed MCL of 0.0002 mg/l is unreasonably low considering the carcinogenic potential and the commenter's position that the half-life of 1,2-dibromo-3-chloropropane in water guarantees that most water systems will reach the proposed MCL through natural processes within 15 years. Another commenter agreed with the comment that 0.0002 mg/l is unreasonably low for an MCL and felt that an MCL for 1,2-dibromo-3-chloropropane should be 0.05 mg/l or higher.

EPA Response. Regarding the epidemiological data for 1,2-dibromo-3-chloropropane, EPA believes the epidemiology data base is inadequate to either refute or demonstrate that 1,2-dibromo-3-chloropropane causes tumors in humans. EPA believes there is sufficient data to conclude that 1,2-dibromo-3-chloropropane is carcinogenic in animals since the compound has been shown to be carcinogenic in both rats and mice. EPA therefore has classified 1,2-dibromo-3-

chloropropane in Group B2: Probable human carcinogen. Consequently, EPA places 1,2-dibromo-3-chloropropane in Category I and an MCLG of zero is promulgated.

f. 2,4-D. EPA proposed an MCLG of 0.07 mg/l for 2,4-D in the November 1985 proposal and again in May 1989 based on adverse effects on the liver and kidney in test animals. EPA based this MCLG on a NOAEL of 1 mg/kg/day, an uncertainty factor of 100, and the assumption that a 70-kg adult consumes 2 liters of water per day. EPA also assumed that 20 percent of total exposure of 2,4-D would be from drinking water. No new relevant data that change EPA's conclusions have become available since publication of the proposals.

EPA also stated that it would consider adopting an MCLG of 0.02 mg/l for 2,4-D, based upon the same study as was used to calculate the proposed MCLG, with the application of an additional uncertainty factor of 3 to the calculations. This uncertainty factor would be applied to account for the fact that supporting long-term data in dogs were not available for 2,4-D.

Public Comments. One commenter stated that EPA ignored the two National Cancer Institute (NCI) studies linking exposure to 2,4-D with an increase of non-Hodgkin's lymphoma, and that since IARC classified chlorophenoxy herbicides in Group B2 (limited evidence of carcinogenicity in humans), EPA should do likewise.

EPA Response. EPA did not ignore the two epidemiological studies published by NCI that reported the possible association of phenoxy herbicides (2,4-D is a member of the class) with cancer. Since the studies dealt with a class of compounds, it is impractical to specifically link 2,4-D as a probable carcinogen. In addition, the contaminants in phenoxy herbicides further cloud the results of these studies.

EPA's proposal for the regulation of 2,4-D was based on inadequate data for the cancer classification and its effects of 2,4-D on the liver and kidney. Controversy regarding the cancer classification of 2,4-D has arisen because of the recently published epidemiological studies on phenoxy herbicides, a class of compounds of which 2,4-D is a member. EPA's Office of Pesticide Programs (OPP) published a notice in the Federal Register (October 13, 1989) stating that an external panel of experts would be convened to advise the Agency on the carcinogenic potential of 2,4-D. However, until the panel of experts convenes and the Agency accepts its results, EPA

continues to categorize 2,4-D as a category III contaminant. Consequently, EPA is promulgating the MCLG of 0.07 mg/l for 2,4-D as proposed.

g. Heptachlor/Heptachlor Epoxide. EPA proposed an MCLG of zero for both heptachlor and heptachlor epoxide based on sufficient evidence of carcinogenicity (Group B2) in animals. Since the May proposal, EPA has revised the DWELs for heptachlor and heptachlor epoxide. A revised DWEL of 0.02 mg/l (rounded from 0.0175 mg/l) was calculated for heptachlor. For heptachlor epoxide, a revised DWEL of 0.0004 mg/l was derived. These revisions of DWELs for heptachlor and heptachlor epoxide do not affect EPA's conclusions about carcinogenicity of these chemicals; however, they are presented to provide more information on health effects.

Public Comments. One organization provided comments in response to the MCLG proposal regarding heptachlor and heptachlor epoxide. The commenter stated that heptachlor and heptachlor epoxide have been incorrectly classified as Group B2 carcinogens and that EPA's Carcinogen Assessment Group report (1986) could not be used to justify such a classification.

EPA Response. According to EPA's guidelines, Group B2 (probable human carcinogen) is used when there is sufficient evidence of carcinogenicity in animals and inadequate data in humans. These guidelines also state that mouse liver tumor data may be used to support sufficient evidence of carcinogenicity. The evaluation of the carcinogenic potential of heptachlor and heptachlor epoxide was based on a sufficient number of rodent studies in which liver carcinomas were induced in two strains of mice of both genders and in CFN female rats.

Consequently, as discussed above, EPA places both heptachlor and heptachlor epoxide in Category I and promulgates an MCLG of zero as proposed.

h. Lindane. EPA repropose an MCLG of 0.0002 mg/l for lindane based upon a DWEL of 0.01 mg/l, an additional uncertainty factor of 10 since lindane was categorized as a category II contaminant (limited evidence of carcinogenicity via drinking water ingestion), and a 20 percent contribution from drinking water. No new data were received that change the conclusions presented in the November 1985 proposal.

Public Comment. One commenter stated that the MCLG should be zero for lindane since lindane was classified as Group C (possible human carcinogen).

EPA Response. The only evidence of carcinogenicity for lindane was in mice and available data do not permit definitive decisions on its oncogenic potential in rats. Since this effect has been reported in only one species, lindane was placed in Category II, and the MCLG values for Category II substances are set based on the RfD. An MCLG of 0.0002 mg/l for lindane is promulgated as proposed.

i. Methoxychlor. EPA proposed an MCLG of 0.4 mg/l for methoxychlor based on a rat study which identified a NOAEL of 5 mg/kg/day and applied an uncertainty factor of 100. However, it was also stated in the EPA proposal of May 22, 1989, that a recent teratology study in rabbits for methoxychlor was under review by OPP. No comments were received during the comment period.

Following the review by the OPP and EPA's RfD Workgroup, an RfD of 0.005 mg/kg/day for methoxychlor was recommended based on this teratology study in rabbits (5-7-90). In this teratology study, a NOAEL of 5 mg/kg/day was identified and an uncertainty factor of 1,000 was applied consisting of 100 for the inter- and intraspecies differences and an additional factor of 10 for the steep dose-response curve and the incompleteness of the data base on chronic toxicity. EPA has placed methoxychlor in Category III but for reasons discussed above the MCLG was changed from the 0.4 mg/l level, as proposed, to 0.04 mg/l in today's rule.

j. Polychlorinated Biphenyls (PCBs). EPA proposed an MCLG of zero for PCBs in the November 1985 proposal and again in May 1989 based on its classification as a Group B2 carcinogen (sufficient animal evidence, inadequate human evidence).

Public Comments. Several commenters submitted information in response to EPA's May 1989 proposal for regulation of PCBs. Major health effects issues were (1) inadequate evidence of carcinogenicity in humans, (2) extent of chlorination and carcinogenicity, i.e., only PCBs with 60 percent plus chlorinated mixtures have been reported to be carcinogenic in animals, and (3) non-mutagenicity of PCBs. One commenter supported EPA's MCLG of 0.5 µg/l PCBs in drinking water. One commenter recommended exploring the feasibility of regulating PCBs based on relative toxicity of PCB congeners, citing the article, "Environmental Occurrence, Abundance and Toxicity of Polychlorinated Biphenyl Congeners: Considerations for a Congener Specific Analysis" (McFarland and Clarke, Environ. Health Perspect., Vol. 81, May 1989, p. 225).

EPA Response. EPA agrees with the commenters that there is inadequate evidence of carcinogenicity of PCBs in humans. However, there is sufficient evidence of carcinogenicity of PCBs in animals, which places PCBs in Group B2 according to the Agency's cancer guidelines. Therefore, according to EPA policy, the MCLG for PCBs is zero. The proposed MCL is 0.0005 mg/l, the practical quantification limit.

PCBs that are 60 percent chlorinated have been reported to be carcinogenic in animals, while PCBs with a lower chlorine concentration (chlorine 54 percent) have produced cancer in animals that was not statistically significant. PCBs are complex mixtures of chlorinated biphenyls, which can contain up to 209 possible isomers; the toxicity of these has not been fully characterized. Therefore, it appears reasonable to regulate PCBs as a class of compounds with a cancer classification of Group B2. FDA also regulates PCBs as a class of compounds rather than individual congeners.

EPA agrees that PCBs are not mutagenic in a bacterial test system; however, this method does not respond to chlorinated hydrocarbons, including PCBs. In addition, a negative mutagenic test does not detract from the carcinogenic potential of PCBs. Therefore, for the above reasons, EPA places PCBs in Category I and promulgates an MCLG of zero.

7. Other Synthetic Organic Contaminant MCLGs

a. Acrylamide. EPA proposed an MCLG of zero for acrylamide in the May 22, 1989 proposal based on a B2 classification for the chemical.

Public Comments. EPA responded to the public comments received in response to the previous proposal of November 13, 1985 in the Federal Register Notice of May 22, 1989. One commenter questioned the B2 classification citing the results of a new acrylamide bioassay by American Cyanamid which indicated that mouse screening studies were not repeatable, that human epidemiology studies were negative, that acrylamide does not produce point mutations, and the acrylamide reacts preferentially with protein.

EPA Response. The current B2 classification for acrylamide is based primarily on the Johnson et al. study (Toxicol. Appl. Pharmacol. 85:154-169, 1986). In this study, the authors reported increased incidences of scrotal mesotheliomas, mammary gland tumors, thyroid adenomas, uterine adenocarcinomas, clitoral gland adenomas, and oral papillomas. In

agreement with the Johnson et al. study, the more recent American Cyanamid study reported statistically significant increases in the incidences of mammary gland tumors (fibroadenomas or fibroadenomas and carcinomas combined), scrotal mesotheliomas, and thyroid neoplasms (adenomas or adenomas and carcinomas combined) in both sexes. The uterine adenocarcinomas, clitoral gland adenomas, and oral papillomas observed in the Johnson et al. study were not found to be increased in the American Cyanamid study. However, there was a positive dose-related trend in the incidence of malignant reticulosis in the brains of females and an increased incidence of astrocytomas (CNS glial tumors) in both sexes at the highest dose level in the American Cyanamid study. After reviewing this study, the Agency has concluded that both studies demonstrate that acrylamide administration resulted in carcinogenicity at more than one site in rats.

Since there are two positive cancer bioassays, the fact that there is some disagreement among the Bull et al. studies (Cancer Res. 44:107-111, 1984a, and Cancer Lett. 24:209-212, 1984b) and the Robinson et al. study (Environ. Health Perspect. 68:141-145, 1986) would not affect the classification of acrylamide.

EPA has reviewed two human epidemiology studies (Collins, American Cyanamid Co., 1984, and Sobel et al., Br. J. Ind. Med. 43:785-788, 1986) and found them to be inadequate for determining the potential carcinogenicity of acrylamide in humans.

Although acrylamide does not induce point mutations, it is a clastogenic agent, inducing chromosomal aberrations, dominant lethality, sister-chromatid exchanges, and unscheduled DNA synthesis (Dearfield et al., Mut. Res. 195:45-77, 1988). Furthermore, the results of a mouse heritable translocation study (Shelby et al., Environ. Mutagen. 9:3263-368, 1987) has shown that acrylamide is an effective inducer of translocations in postmeiotic germ cells, suggesting that acrylamide may pose a heritable risk concern in mammals.

While it is certainly correct to state that acrylamide preferentially reacts with protein (Sega et al., Mut. Res. 216:221-220, 1989), it also reacts with nucleic acids *in vivo* (Carlson and Weaver, Toxicol. Appl. Pharmacol. 79:307-313, 1979) and *in vitro* (Solomon et al., Cancer Res. 45:3465-3470, 1985). Accordingly, it is not possible to rule out the possibility of acrylamide-DNA interaction. Due to the two positive acrylamide bioassays and other data,

EPA retains a B2 classification for acrylamide and places it in Category I with an MCLG of zero.

B. Establishment of MCLs

1. Methodology for Determination of MCLs

The SDWA directs EPA to set the MCL "as close to" the MCLG "as is feasible." The term "feasible" means "feasible with the use of the best technology, treatment techniques, and other means, which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking costs into consideration)." (SDWA section 1412(b)(5)). Each Nation's Primary Drinking Water Regulation that establishes an MCL lists the technology, treatment techniques, and other means which the Administrator finds to be feasible for meeting the MCL (SDWA section 1412(b)(6)).

The present statutory standard for "best available technology" (BAT) under 1412(b)(5) represents a change from the provision prior to 1986, which required EPA to judge feasibility on the basis of "best technologies generally available" (BTGA). The 1986 Amendments to the SDWA changed BTGA to BAT and added the requirement that BAT must be tested for efficacy under field conditions, not just under laboratory conditions. The legislative history explains that Congress removed the term "generally" to assure that MCLs "reflect the full extent of current technology capability" [S. Rep. No. 56, 99th Cong., 1st Sess. at 8 (1985)]. Read together with the legislative history, EPA has concluded that the statutory term "best available technology" is a broader standard than "best technology generally available," and that this standard allows EPA to select a technology that is not necessarily in widespread use, as long as it has been field tested beyond the laboratory. In addition, EPA believes this change in the statutory requirement means that the technology selected need not necessarily have been field tested for each specific contaminant. Rather, EPA may project operating conditions for a specific contaminant using a field tested technology from laboratory or pilot systems data.

Based on the statutory directive for setting the MCLs, EPA derives the MCLs based on an evaluation of (1) the availability and performance of various technologies for removing the contaminant, and (2) the costs of applying those technologies. Other technology factors that are considered

in determining the MCL include the ability of laboratories to measure accurately and consistently the level of the contaminant with available analytical methods. For Category I contaminants, the Agency also evaluates the health risks that are associated with various levels of the contaminants, with the goal of ensuring that the maximum risk at the MCL falls within the 10^{-4} to 10^{-6} risk range that the Agency considers protective of public health, therefore achieving the overall purpose of the SDWA.

EPA's initial step in deriving the MCL is to make an engineering assessment of technologies that are capable of removing a contaminant from drinking water. This assessment determines which of those technologies are "best." EPA reviews the available data to determine technologies that have the highest removal efficiencies, are compatible with other water treatment processes, and are not limited to a particular geographic region.

Based on the removal capabilities of the various technologies, EPA calculates the level of each contaminant that is achievable by their application to large systems with relatively clean raw water sources. [See H.R. Rep. 1185, 93rd Cong., 2nd Sess. at 13, (1974); 132 Cong. Rec. S6287, May 21, 1986, statement of Sen. Durenberger.]

When considering costs to control the contaminants in this rule, EPA analyzed whether the technology is reasonably affordable by regional and large metropolitan public water systems [see H.R. Rep. No. 93-1185 at 18 (1974) and 132 Cong. Rec. S6287 (May 21, 1986) (statement of Sen. Durenberger)]. EPA also evaluated the total national compliance costs for each contaminant considering the number of systems that will have to install treatment in order to comply with the MCL. The resulting national costs vary depending upon the concentration level chosen as the MCL. The more stringent the MCL, the greater the number of systems that may have to install BAT in order to achieve compliance. In today's rule, EPA has determined that costs for large systems and total national compliance costs at the MCL are reasonably affordable and, therefore, feasible. Therefore, alternative MCLs were not considered.

The feasibility of setting the MCL at a precise level is also influenced by laboratory ability to measure the contaminant reliably. EPA derives practical quantitation levels (PQLs) which reflect the level that can be measured by good laboratories under normal operating conditions within specified limits of precision and

accuracy. Because compliance with the MCL is determined by analysis with approved analytical techniques, the ability to analyze consistently and accurately for a contaminant at the MCL is important to enforce a regulatory standard. Thus, the feasibility of meeting a particular level is affected by the ability of analytical methods to determine with sufficient precision and accuracy whether such a level is actually being achieved. This factor is critically important in determining the MCL for contaminants for which EPA sets the MCLG at zero, a number which by definition can be neither measured nor attained. Limits of analytical detection require that the MCL be set at some level greater than the MCLG for these contaminants. In these cases, EPA examined the reduction capability of BAT and the accuracy of analytical techniques as reflected in the PQL to establish the appropriate MCL level.

EPA also evaluates the health risks that are associated with various contaminant levels in order to ensure that the MCL adequately protects the public health. For drinking water contaminants, EPA sets a maximum reference risk range 10^{-4} to 10^{-6} excess individual risk from for carcinogens at lifetime exposure. This policy is consistent with other EPA regulatory programs that generally target this range using conservative models that are not likely to underestimate the risk. Since the underlying goal of the Safe Drinking Water Act is to protect the public from adverse effects due to drinking water contaminants, EPA seeks to ensure that the health risks associated with MCLs for carcinogenic contaminants are not significant.

Below is a detailed discussion of the Agency's response to the comments on the proposed rule and how today's MCLs were determined. EPA is repropose for public comment the MCLGs and MCLs for aldicarb, aldicarb sulfoxide, aldicarb sulfone, barium, and pentachlorophenol due to a change in the health basis for the standard. However, regardless of the final standards which are established, EPA believes the BAT and analytical methods promulgated today will not be affected by the new standards. Consequently, those requirements are promulgated today.

2. Inorganic Analytical Methods

In the May 1989 notice, the Agency proposed a list of analytical methods to be used for measuring eight inorganic chemicals (IOCs) that it considered economically and technologically feasible for monitoring compliance.

These methods are promulgated today as proposed with the exception of the revisions that will be discussed below (see Table 9). These methods were selected based on the following factors: (1) reliability (i.e., precision/accuracy) of the analytical results; (2) specificity in the presence of interferences; (3) availability of enough equipment and trained personnel to implement a national monitoring program (i.e., laboratory availability); (4) rapidity of analysis to permit routine use; and (5) cost of analysis to water supply systems.

Table 9 lists the analytical methods that EPA is approving for use to comply with the monitoring requirements. EPA has updated the references to the most recent editions of the manuals, including the atomic absorption and emission methods for metals; the transmission electron microscope method for asbestos; and the colorimetric, spectrophotometric, potentiometric, and ion chromatography methods for nitrate and nitrite.

The reliability of analytical methods used for compliance monitoring is critical at the MCL. Therefore, the analytical methods have to be evaluated with respect to the accuracy or recovery (lack of bias) and precision (good reproducibility) at the range of MCL.

When NPDWRs are revised or new regulations are proposed, the Agency examines all appropriate methodologies, including any minor modifications of the method that may have been approved for limited use, and only those methods which meet all the necessary criteria are proposed. Public comments on the applicability of these methods are taken into consideration when the rule is finalized.

In view of this, only the analytical procedures specified in this final rule can be used for compliance monitoring after this rule is promulgated. The Agency is aware that minor modifications to specific methods have been previously approved for limited use by various laboratories. These approvals will cease upon the effective date of this rule. New methods, new applications of current methods, and any modification to method approved in the future will be published in the Federal Register, thus making these changes available to all laboratories.

a. Asbestos. Several commenters submitted comments expressing concerns with the following: (1) The expense of Transmission Electron Microscopy (TEM) analysis for asbestos; (2) the number of laboratories available with TEM capabilities; (3) the quantitative analytical precision and accuracy of the TEM method; and (4) the

absence of other asbestos methods on the list of methods. EPA recognizes that TEM analysis is somewhat more expensive than other conventional analyses for most analytes that are regulated under the SDWA. However, the overall national cost should be lessened because of the reduced number of systems affected by the monitoring requirements after the vulnerability assessment, resulting in a limited number of samples for analyses.

EPA believes that sufficient analytical capacity will exist for those water systems that are deemed vulnerable because public water systems will have approximately five years from publication of the final rule to complete the monitoring (i.e., December 31, 1995), thus allowing the analytical capability to develop. In addition, EPA is currently participating in a cooperative program with the National Institute of Standards and Technology (NIST) to certify a pool of laboratories that can perform asbestos analysis using the TEM method.

A performance evaluation (PE) sample is currently being developed by the Agency to assess laboratory performance using the TEM method. Furthermore, the EPA facility in Athens has produced interlaboratory and intralaboratory (single laboratory) studies to verify the method's performance and capabilities.

Other asbestos analytical methods were considered and evaluated but they were found to be inadequate and inferior to the TEM method. The Agency has determined that TEM is the best available technique because of its specificity of asbestos fibers (chrysotile versus amphibole), its effectiveness in distinguishing between asbestos and nonasbestos fibers, and its ability to determine the number of fibers per volume and fiber size (length and width). Furthermore, the MCLG for asbestos was assessed using data resulting from TEM analyses. The analysis of waterborne asbestos by different techniques can yield radically different results, unlike the methodology of other analytes. EPA believes it is imperative to ensure comparability that the analytical technique required for monitoring water quality samples be the same as that used to assess the MCLG. EPA, however, continues to desire additional screening methodology and encourages the public to inform the Agency when a potential technique may exist. If additional methods become available that meet the MCL requirement, EPA will promptly update the rule to permit alternatives to the TEM method.

b. Nitrate/Nitrite. Several commenters addressed concerns about the ability of laboratories to analyze nitrite because of its unstable character and associated analytical problems. EPA evaluated the most recent available data resulting from Water Supply (WS) PE studies #022-025, in which various approved methods were used, to determine laboratory performance for nitrite. The acceptance limits calculated from this data for the EPA, State, and non-EPA laboratories that participated in the studies demonstrate successful nitrite analyses as compared to the acceptance limits of the other regulated contaminants as summarized in table 12.

One commenter stated that there are conflicting opinions whether to use single (Waters method B-1011) or dual (EPA Method 300.0) column chromatography for nitrate analysis. EPA evaluated data from a comparability study for both of the methods and concluded that they both were successful in analyzing nitrate, i.e., precision, accuracy, and acceptance limits criteria were met.

Some commenters also objected to the deletion of the colorimetric brucine method for nitrate from the list of methods. EPA evaluated the most recent available data from the laboratories that used the brucine method for WS PE studies #020-025. The review of the data demonstrated the inability of the method to produce results that met the acceptance limits criteria, thus its elimination from the list of approved methods.

c. Other Inorganic Analyses. Several commenters stated that EPA Method 200.7 (Inductively Coupled Plasma-Atomic Emission Spectrometric Method (ICP-AES)) without the appendix (EPA Method 200.7A) is applicable for the analysis of barium and chromium and objected to its omission from the list of methods. EPA concurs with this assessment of the method and will permit its use as an additional optional method for the analysis of barium and chromium. However, the appendix (200.7A) must be followed in processing drinking water samples prior to ICP-AES analysis for cadmium, because Method 200.7 is not sensitive enough for cadmium samples at the MCL level in this rule.

One commenter recommended the deletion of the gaseous hydride EPA Method 270.3 for selenium from the list of methods because of its referral to a method that is no longer cited. EPA recognizes this inconsistency and has deleted this method from the list of approved methods because it is an incomplete method that references

Standard Methods (SM) 404B in the 14th edition for analytical details. SM 404B has been replaced by SM 303E in the 16th edition, which is decidedly improved and is on the list of approved methods.

Several commenters objected to the deletion of the atomic absorption (AA) direct aspiration methods for cadmium and chromium from the list of methods. The Agency deleted these methods from the list because they do not provide adequate sensitivity to meet the specific performance requirements for these analytes. In addition, the evaluation of data when using the method for these analytes, as demonstrated by the review of the most recent available WS PE studies #020-025, revealed high data variability.

d. Method Detection Limits and Practical Quantitation Level. EPA determines practical quantitation levels (PQLs) for each substance for the purpose of integrating analytical chemistry data into regulation development. This becomes particularly important where MCLs are zero or some other very low number, near or below the detection limit. The PQL yields a limit and specific precision and accuracy requirement which EPA uses to develop monitoring requirements. As such, PQLs are a regulatory device rather than a standard that labs must specifically demonstrate. The following is a discussion of how EPA used PQLs to set the standards in this rule.

(1) Inorganics

The PQLs and the acceptance limits for the inorganic contaminants, except for nitrite and asbestos, were determined using WS PE studies #012-017 as detailed in the proposal and summarized in table 8. One commenter suggested that current WS PE studies should be included in the assessment of the analytical acceptance limits and PQLs for the inorganic contaminants to provide an even broader data base reflective of overall analytical and laboratory performance capabilities. The Agency concurs with this and, in fact, has established the practice of periodically reviewing and evaluating the most recent studies, when they become available, to determine the necessary updates for the regulated contaminants. WS PE studies #020-025, as applicable, were evaluated and they verified that laboratories are continuing to demonstrate the ability to meet the established acceptance limits and PQL criteria as documented in table 16, with the exception of nitrite, which is addressed below.

(2) Nitrite

The "plus or minus percent of true value" acceptance limits for expected performance and the PQL for nitrite, as reported in table 15, were proposed based on the analytical procedures being the same as and the method detection limits similar to nitrate. This approach was used because data (PE

studies) were not available to assess the acceptance limits and PQL for nitrite. However, EPA has evaluated the most recent data now currently available from nitrite analyses WS PE studies #022-025, and has determined that the acceptance limits and PQL for nitrite will be ± 15 percent and 0.4 mg/l, respectively, in the final rule (see table 16).

TABLE 16.—INORGANIC CONTAMINANT ACCEPTANCE LIMITS AND PRACTICAL QUANTITATION LEVELS

Inorganic contaminant	MCL (mg/l)	Acceptance limits (plus or minus percent of the true value)	PQLs (mg/l)
Barium ¹	2	15	0.15
Cadmium	0.005	20	0.002
Chromium	0.1	15	0.01
Mercury	0.002	30	0.0005
Nitrate	10	10	0.4
Nitrite	1	15	0.4
Selenium	0.05	20	0.01

¹ MCL is the proposed level.

e. Inorganic Chemical Sample Preservation, Container, and Holding Time. EPA is specifying that the maximum holding time for mercury in the sample collection table be revised to specify 28 days for glass or plastic containers. This change will provide consistency with the recommended holding time for wastewater (CFR 40 136.6, table II), the source of the specifications for the rule (see table 17).

TABLE 17.—INORGANIC CONTAMINANT SAMPLE PRESERVATION, CONTAINER, AND HOLDING TIME REQUIREMENTS

Contaminant	Preservative ¹	Container ²	Maximum holding time ³
Asbestos	Cool, 4 °C	P or G	
Barium	Conc HNO ₃ to pH <2	P or G	6 months
Cadmium	Conc HNO ₃ to pH <2	P or G	6 months
Chromium	Conc HNO ₃ to pH <2	P or G	6 months
Fluoride	None	P or G	1 month
Mercury	Conc HNO ₃ to pH <2	P or G	28 days
Nitrate	Cool, 4 °C	P or G	48 hours
Nitrate/Nitrite	Conc H ₂ SO ₄ to pH <2	P or G	28 days
Nitrite	Cool, 4 °C	P or G	48 hours
Selenium	Conc HNO ₃ to pH <2	P or G	6 months

¹ If HNO₃ cannot be used because of shipping restrictions, sample may be initially preserved by icing and immediately shipping it to the laboratory. Upon receipt in the laboratory, the sample must be acidified with conc HNO₃ to pH <2. At time of analysis sample container should be thoroughly rinsed with 1:1 HNO₃, washings should be added to sample.

² P = plastic, hard or soft; G = glass, hard or soft.

³ In all cases, samples should be analyzed as soon after collection as possible.

3. SOC Analytical Methods

a. VOC Methods. Most commenters supported the analytical methods as proposed. However, several changes and clarifications of the proposal are made in this notice. Four commenters felt Methods 502.2 and 524.2 should not be implemented at this time. The commenters felt it would be difficult to

implement the use of capillary column and that input should have been obtained from the laboratory community that the methods were not technically available for routine use. Three of the commenters felt there was a problem in meeting the quality control (QC) requirements in the methods, particularly for Method 524.2. One of the

commenters reported difficulty with water desorbing from the trap (which is used in the purge and trap devices to retain VOCs for analysis). One commenter felt regulating cis- and trans-1,2-dichloroethylene separately forces the use of Method 524.2 to achieve resolution, but permits co-elution of other VOCs. The commenter felt this

situation would necessitate the use of a capillary column.

Methods 502.2 and 524.2 were developed as a result of public comment. EPA proposed MCLs for eight VOCs on November 13, 1985 (50 FR 48902). Commenters recommended the use of capillary column techniques, and EPA agreed and developed methods 502.2 and 524.2. These were proposed in the April 17, 1987 notice (52 FR 12879) and finalized in the July 8, 1987 notice (52 FR 25702).

Water desorption from the trap is a problem common to all purge and trap methods in EPA's 500, 600, and 8000 series. The problem is particularly acute in the gas chromatograph/mass spectrometry (GC/MS) methods, but can be minimized by following the trap bake-out procedures in § 11.4 in both Methods 502.2 and 524.2.

When monitoring a large number of unknown compounds with the possibility of co-eluting substances, use of confirmatory columns is necessary even for GC/MS techniques. Method 524.2 allows the use of three different chromatographic columns under four different sets of operating conditions, allowing a greater differentiation and resolution of VOCs than any other 500 series VOC method.

EPA notes the QC requirements in Method 524.2 are identical to those in Method 524.1. These requirements were demonstrated by three different analysts using three different columns.

Summarized data for WS studies 20-24 for the regulated and unregulated VOCs indicate non-EPA, non-State laboratories can successfully utilize Methods 502.2 and 524.2. Approximately 500 labs now analyze VOCs. The use of Methods 502.2 and 524.2 has also increased as a result of WS studies 20-24. Seventy-five percent of the labs reporting a method use either Method 502.2 or 524.2. For these reasons, EPA will continue to approve Methods 502.2 and 524.2.

b. Method Availability. Ten commenters felt there were too many methods for the individual pesticides and that the available methods required second column confirmation, resulting in excessive costs. The commenters felt EPA should wait until suitable GC/MS methods are available before regulating these pesticides. EPA assessed the impact of regulation, if monitoring was implemented for these pesticides, and found the costs were not excessive, estimated at \$180 or less per sample. Furthermore, the vulnerability concept in this regulation should limit the number of water supplies that will monitor any or all of these pesticides. The commenters further stated that if all

the pesticides were present at the same time, particularly the multi-peak residues, chlordane, toxaphene, and PCBs, only GC/MS could distinguish them.

EPA has in fact found through numerous national surveys for pesticides and PCBs, including the current National Pesticide Survey (NPS) and other programs like Superfund, that the pesticides in this rule do not all occur at the same sites. However, EPA agrees with the commenters that GC/MS is the most economical procedure and indicated in the May 22, 1989 proposal that it was investigating GC/MS methods. Data supplied by commenters and EPA's Environmental Monitoring and Systems Laboratory (EMSL) demonstrate EPA Method 525, discussed below, which was proposed for monitoring unregulated contaminants, can be utilized as a primary analytical technique for the majority of the pesticides. Consequently, for the reasons cited above, EPA is promulgating Method 525.

c. Cleanup Procedures. Four commenters took issue with the lack of cleanup procedures for the pesticide methods. Laboratory methods addressing contaminants under the SDWA are for finished drinking water. Most of the pesticide methods listed below were derived from the methods used in the National Pesticide Survey; cleanup techniques were not included in most of the methods since experience has shown even a clean groundwater sample does not usually need sample cleanup, which would only add unnecessary cost.

d. Pesticide Methods. Several commenters pointed out that Method 504 is the same as Method 505. EPA agrees that the methods are similar except for temperature programming of the gas chromatograph and that theoretically the compounds run in Methods 504 and 505 could be run in the same analysis. In the absence of persuasive data, however, EPA believes it is better to isolate the two volatility ranges in separate analyses.

In an interlaboratory study of Method 505 (U.S. EPA Method Study 40), no significant differences could be seen in the recoveries of the analytes in reagent water and ground water, which ranged from 90 to 120 percent. Precision as represented by the relative standard deviation (%RSD) ranged from 11 to 30 percent for the analytes in reagent water and from 11 to 40 percent in ground water. Both the interlaboratory studies and Water Supply Studies indicated Method 505 is not recommended to analyze atrazine.

Several commenters complained about the use of diazomethane as the esterifying agent in Method 515.1. While EPA laboratories have used this reagent safely for many years, EPA agrees this is a matter of concern and is attempting to resolve this situation. In the interim, those laboratories that do not wish to use diazomethane can use the derivatization procedure in the packed column methods currently cited in 40 CFR 141.24 (f) for 2,4-D and 2,4,5-TP. Pentachlorophenol can be analyzed by Method 525.

e. Method 525. Eleven commenters commented about the lack of a GC/MS method to cut down on the number of methods, reduce the cost of compliance monitoring, and provide a positive identification.

EPA stated in the proposed rule that it was investigating GC/MS methods for those analytes that use gas chromatography. EPA Method 525, "Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction (LSE) and Capillary Column Gas Chromatography/Mass Spectrometry," was proposed as an analytical technique for monitoring unregulated contaminants under § 141.40, Special Monitoring for Inorganic and Organic Chemicals. At the time the rule was proposed, sufficient data were not available for the regulated analytes. During public hearings and in the comment period, data supporting expanded use of this method were submitted by three commenters, including EPA's Environmental Monitoring and Systems Laboratory (EMSL), and from WS study 23. An improvement evaluated by EMSL was the use of C-18 LSE discs as well as the C-18 LSE cartridges. In using Method 525, analytes, internal standards, and surrogates are extracted from water by passing a liter sample of water through cartridges or discs coated with chemically bonded C-18 organic phase (liquid-solid extraction, LSE). The sample components are eluted from the LSE with a small quantity of methylene chloride, which then is evaporated a volume of to 0.5-1.0 ml. The sample components are identified and quantified by using a high resolution capillary column/GC/MS system. The pesticides in this rule were run with the two extraction systems on three types of mass spectrometer systems—ion trap, magnetic sector, and quadrupole. Alachlor, atrazine, chlordane, heptachlor, heptachlor epoxide, lindane, methoxychlor, and pentachlorophenol can be extracted by the use of Method 525. The method specifies an accuracy range for analytes and surrogates of 70

o 130 percent and a precision less than or equal to 30 percent, which the listed analytes can meet. Use of Method 525 allows monitoring of regulated and unregulated compounds simultaneously and can eliminate five other analytical methods. Consequently, EPA is promulgating EPA Method 525 for the analysis of alachlor, atrazine, chlordane, heptachlor, heptachlor epoxide, lindane, methoxychlor, and pentachlorophenol.

f. PCB Analytical Methods. In the proposed rule, EPA stated it had evaluated existing methods which, for the most part, are adaptations of chlorinated pesticide procedures. EPA explained the difficulty in applying these procedures to finished drinking water due to the removal of specific congeners by the treatment process. In the proposed rule EPA outlined an approach which would give a quantitative answer for total PCBs while minimizing false positives.

Thirty-two commenters expressed views on PCBs. Sixteen did not like the current EPA procedure of Methods 505 and 508 to screen, and Method 508A for quantitation. Seven commenters wanted EPA to develop a GC/MS procedure before regulating PCBs. Five commenters were concerned about false positives generated by perchlorination or biphenyl and related compounds. Seven commenters felt the method detection limits (MDLs) and PQLs were too low or incorrect; they felt the regulated community could not meet them. The rest of the commenters cited problems with availability and cost of methods, the unsuitability of Method 505, and the lack of performance evaluation data.

EPA has evaluated various available methods, as stated above. None of these analytical schemes gives a reliable quantitative answer to environmentally degraded PCB samples, nor were any provided by the commenters. Accordingly, the proposed procedure for PCB analysis is supported by performance and is made final.

Because of poor participation by the public sector laboratories, data utilized from Water Supply (WS) studies 23-25 were from non-EPA, non-State laboratories. These data showed that these laboratories could screen and quantitate down to 0.1 µg/l total PCB, for commonly occurring aroclors such as 1242 and 1254 using the protocol stated in the proposed rule. EPA has determined that these performance data support the PQL of 0.005 mg/l for total PCBs. The apparent discrepancy in the MDLs obtained with screening by Method 505 or 508 and quantitation by Method 508A indicate that the MDLs for Method 508A represent the amount of

the particular aroclor needed to reach the detection limit of decachlorobiphenyl, which is 71 percent chlorine. Typical aroclor designations 1221 or 1260 represent 21 percent and 60 percent average chlorine content, respectively. Aroclor 1221 is composed mostly of biphenyl, monochloro, and dichlorobiphenyl congeners with poor sensitivity to electron-capture detectors, giving it an MDL of 0.02 mg/l. Conversion to the detection level of decachlorobiphenyl takes only a fraction of this amount. Conversely 1260, as expected, shows little increase in sensitivity as decachlorobiphenyl.

EPA evaluated the problem of false positives with Method 508A. In the proposed rule, EPA required screening using Methods 505 or 508 to ensure PCBs were actually present. EPA explained that these methods are not used for actual quantitation because high resolution capillary chromatographic columns used in Methods 505, 508, and 508A can co-elute compounds such as chlordane, thus adding to the apparent concentration of PCBs. Method 508A, by converting all the PCBs to decachlorobiphenyl, separates this total PCB from potential co-elutants due to its longer retention time in the gas chromatograph. This improved specificity adequately compensates for potential perchlorination of biphenyl or related compounds.

Interlaboratory studies now available for Method 505 and WS data indicate Method 505 is suitable as a screening method for PCBs. WS studies indicate about half the non-EPA, non-State laboratories use Method 505 as a screening method. EPA has looked at the MDL for GC/MS methods, including Method 525, and, at this time, no GC/MS technique will meet its requirements. EPA feels the cost of the analysis is reasonable since the PCB screen is done as part of the chlorinated pesticide analysis.

g. VOC Performance Studies. A number of commenters stated that they were unable to meet the ±20 percent/40 percent performance requirements for VOCs first established July 8, 1987. Updated WS studies 20-24 indicate that EPA's decision to establish acceptance limits for VOCs at ±40 percent of the true value for concentrations less than 10 µg/l and ±20 percent at concentrations 10 µg/l or above was correct. The results of these studies are in the docket for this rule.

EPA originally expected the percentage of private commercial laboratories able to meet the specified performance limits to be much lower. Summarized data for regulated and unregulated VOCs from WS20-24

indicate improvement to the point that there is no significant difference in performance between the public and private laboratories for most VOCs. Private commercial laboratories show continuing improvement as they gain experience using the analytical methodology.

Four commenters questioned the PQLs established for VOCs in Phase II. They felt the original PQLs of 0.005 mg/l (5 µg/l) based upon MDLs of 0.2-0.5 µg/l reported by seven EPA and EPA contract laboratories were erroneous. The commenters felt these stringent PQLs resulted in MCLs for three carcinogens—1,2-dichloropropane, styrene, and tetrachloroethylene—that many laboratories would not be able to accurately measure.

EPA revised its VOC methods in December 1988 with new MDLs. WS data (WS20-24) indicate 60 to 75 percent of reporting laboratories now use the capillary column Methods 502.2 and 524.2. These methods have MDLs ranging from 0.01 to 0.05 µg/l for the VOCs in this regulation. The WS data for WS studies show the laboratories have been challenged with at least one sample at or below the 0.005 mg/l PQL. The performance data indicate that the use of the 0.005 mg/l PQL establishes a level for adequate performance for non-EPA, non-State laboratories.

h. Pesticide/PCB PQL and Performance Acceptance Limits. In the May proposal, EPA estimated pesticide/PCB PQLs based on 10 times the minimum detection limits (five times for EDB and toxaphene). EPA stated that ongoing performance evaluation studies would determine whether the estimated PQLs are achievable. Performance data now available from WS studies 22-24 (23-25 for PCBs) for the non-EPA, non-State laboratories show this approach was justified. WS studies 22-25 had values bracketing the PQL/MCL for most pesticides. In some cases, the WS data indicated the PQL could be lowered from the levels proposed in May 1989.

Fifteen commenters responded to EPA's procedures for setting MDLs and PQLs. Most of these commenters took issue with EPA estimating the PQLs at five times the Interlaboratory Method Detection Limit (IMDL) for EDB and toxaphene. Six commenters complained about using the single laboratory MDL to set the PQL for PCBs. Two of the commenters had the same complaint about atrazine. Several commenters stated that precision and accuracy are sacrificed to attain a lower level of detection.

Performance data now available from WS studies 22-25 indicate non-EPA, non-State laboratories can screen pesticides for PCBs at 0.1 µg/l. The interlaboratory performance data support the PCB PQL of 0.5 µg/l. Data for atrazine from WS studies 22-24 and from EPA Method Study #40 using Method 507 support a PQL of 0.001 mg/l, as proposed.

Several commenters cited the large gap between some of the proposed PQLs and the MCLs. EPA agrees, and in the case of Silvex, 2,4-D, and methoxychlor, has raised the PQL. Raising the PQL should result in increased precision and accuracy for most laboratories. Because the MCLs for Silvex, 2,4-D, and methoxychlor are set at a level equal to

the MCLG, raising the PQL has no effect on the MCL or the health basis of the standard. In the case of toxaphene, performance data indicated the PQL should be lowered from 0.005 mg/l to 0.003 mg/l.

Data showed that the PQLs for aldicarb and aldicarb sulfoxide could be lowered from 0.005 and 0.008, respectively, to 0.003 mg/l. Likewise, water supply data showed that the PQL for pentachlorophenol should be raised from 0.0001 mg/l, as proposed, to 0.001 mg/l. The PQLs for aldicarb, aldicarb sulfoxide, aldicarb sulfone, and pentachlorophenol are repropose elsewhere in today's Federal Register for additional comment.

Acceptance limits have been calculated from WS studies 22-25 using regression equations derived from the data. The acceptance limits were calculated at a 95 percent confidence interval at the MCLG or at the MCL if the MCLG was zero. The raw water supply data were plotted both at the acceptance limits and as a percentage around the true value to find a point at which 75 percent of the laboratories passed. Most of the limits were calculated from non-EPA, non-State data due to poor participation of the public sector laboratories. Table 18 lists the acceptance limits for the 18 pesticides/PCBs in this rule.

TABLE 18.—PESTICIDE/PCB PRACTICAL QUANTITATION LEVELS AND ACCEPTANCE LIMITS

Contaminant	Final MCL	Acceptance limits (percent)	Final PQL (mg/l)	Proposed PQL
DECP	0.0002	±40	0.0002	0.0002
ECB	0.00005	±40	0.00005	0.00005
Aldicarb	0.002	±45	0.002	0.002
Atrazine	0.003	±45	0.001	0.001
Carbofuran	0.04	±45	0.007	0.007
Chlordane	0.002	±45	0.002	0.002
Heptachlor	0.0004	±45	0.0004	0.0004
Heptachlor epoxide	0.0002	±45	0.0002	0.0002
Lindane	0.0002	±45	0.0002	0.0002
Methoxychlor	0.04	±45	0.01	0.001
PCBs (as Decachlorobiphenyl)	0.0005	0-200	0.0005	0.0005
Toxaphene	0.003	±45	0.003	0.005
Aldicarb ¹	0.001	±55	0.003	0.005
Aldicarb sulfoxide ¹	0.001	±55	0.003	0.008
Aldicarb sulfone ¹	0.002	±55	0.003	0.003
Pentachlorophenol ¹	0.0001	±50	0.001	0.0001
2,4-D	0.07	±50	0.005	0.001
2,4,5-TP	0.05	±50	0.005	0.0002

¹ MCL is the proposed level.

4 Selection of Best Available Technology

c. Inorganics. To fulfill the requirements of Section 1412(b)(6), regarding the selection of treatment techniques that the Administrator finds to be feasible for meeting each MCL, EPA proposed best available technologies (BATs) for each of the inorganic contaminants, as summarized in Table 16 of the Federal Register Notice of May 22, 1989. BATs were selected on the basis of documented efficiency in removal of each contaminant, commercial availability of the technologies, compatibility with other water treatment processes, and feasibility. Among the BATs proposed were conventional processes, such as lime softening and coagulation/filtration, and less commonly applied technologies such as activated alumina and reverse osmosis. All BATs for each inorganic contaminant were discussed

in the May 22, 1989 proposal, and extensive review of performance information and lab, pilot, and full-scale data are contained in EPA Technologies and Costs (T & C) documents for each inorganic covered by the proposal. These documents were referenced in the proposal and are part of the official EPA docket for this regulation. Table 6 summarizes the BAT for the inorganics for today's rule. As discussed below, the BATs (except electrodialysis) are identical to those proposed in May 1989.

One commenter supplied information regarding electrodialysis reversal (EDR), a membrane technology, and asserted that the information supplied to EPA confirms the use of EDR as BAT for all but asbestos of the inorganic contaminants addressed in the proposal of May 22, 1989. The information, much of which had previously been submitted to EPA and reviewed by EPA staff, consisted of consulting engineering studies, product literature from the

company that markets the technology, correspondence records, historical information regarding applications of electrodialysis for drinking water and industrial wastewater treatment, technology and cost information, and general discussions regarding the capabilities of EDR and other technologies in the treatment of brackish waters.

The commenter sought a detailed response from EPA regarding EDR, formally requesting that EPA address several (a total of six) points which question EPA's rationale for excluding EDR as a BAT for the seven subject inorganics in the proposal. The commenter requested EPA documentation regarding its response to previous electrodialysis related correspondence, and also requested EPA's explanation regarding any exclusions of EDR as BAT in the final regulation. The EPA Comment/Response document contains the

detailed response of EPA to each of the commenter's concerns.

EPA reviewed the comments regarding electrodialysis (EDR), including materials sent by the commenter in January 1990 in response to a request by EPA to provide clear data to support some of the commenter's claims. Field tests and full-scale operating data from electrodialysis plants treating public water supplies confirm that EDR is capable of efficiently removing barium (88 percent on average), nitrate (51 percent to 92 percent), and selenium (71 percent removal). The EDR data, most of which

were collected during a study by New Mexico State University, demonstrate that EDR technology is appropriate and feasible, and that it is capable of efficiently reducing source water barium, nitrate, and selenium, as well as other frequently occurring salts found in moderately brackish waters. Based upon the data submitted to the Agency by the commenter, EPA has concluded that EDR is a BAT for removal of barium, nitrate, and selenium.

In regard to the four other inorganic contaminants that are subject to this regulation (i.e., cadmium, chromium, mercury, and nitrite), EPA found that the

available data could not support a conclusion regarding EDR as a BAT. Many of the claims made by the commenter were not referenced or supported by actual data. EDR removal efficiencies cited within the comments were generally lower than efficiencies of proposed BATs. Therefore, EDR was found not to be equivalent to the proposed BATs in removal of the four other inorganics. Table 19 illustrates the difference between the efficiencies of removal obtained by applying the proposed BATs and those achieved by EDR.

TABLE 19.—ELECTRODIALYSIS PERFORMANCE COMPARED TO PROPOSED BATs

	Proposed BAT removal efficiencies	Electrodialysis removal efficiencies	BAT
Barium	90-98 percent	58-94 percent ¹	Yes.
Cadmium	80-98 percent	70-75 percent ²	No.
Chromium	82-99 percent	86-91 percent ²	No.
Mercury	40-100 percent	Data inconclusive	No.
Nitrate	67-99 percent	51-82 percent ¹	Yes.
Nitrite	67-99 percent	70 percent ¹	No.
Selenium	75-99 percent	71 percent ¹	Yes.

¹ Data from drinking water pilot study.

² Data from industrial wastewater applications of electrodialysis technology.

In addition to the low EDR efficiencies evident in the commenter-supplied reports, many of the data are inappropriate because they were collected at sites employing EDR to separate and/or recover industrial wastewater contaminants. Operating conditions at plants treating drinking water would clearly be different than at plants treating industrial wastes. To determine efficacy of treatment, EPA relies on quality data obtained under verifiable conditions which would be replicated under typical drinking water treatment conditions.

EPA would welcome reports, data, and any additional test results on the EDR process applied to drinking water so that in the future the Agency may be able to determine the status of this technology as a potential BAT for removal of any contaminant to be regulated under the SDWA.

Because EDR is a newly recognized BAT for barium, nitrate, and selenium, EPA feels that it is appropriate to describe some aspects of the EDR process and address treatment costs associated with EDR application to drinking water. Electrodialysis is a membrane process that separates ionized or charged (anionic and cationic) substances in feed water by allowing ions to pass through transfer membranes. The membranes are configured in "stacks," parallel to one another, and each successive membrane

carries a direct electric current which is either positive (cathode) or negative (anode), in alternate fashion. Cations migrate through the cathode membrane and anions migrate through the anode membrane, yielding partially deionized water and concentrated wastewater in alternating stacks which flow out of the unit, or are recycled or recirculated through additional treatment stages to reach the desired product.

A modification and improvement to the electrodialysis process is the automatic reversal of polarity, from positive to negative, of direct current across each membrane at regular 15 to 30 minute intervals. Automatic polarity reversal causes ion movement to reverse, switching product and concentrate streams. By this process, foulants and scale tend to slough off of membranes and are purged along with the waste stream. This self-cleaning mechanism appears to extend membrane life to 5 to 10 years. Another advantage of EDR over other membrane processes is EDR's apparent ability to achieve greater product recovery (up to 95 percent), thus producing a smaller water stream to dispose (Zeiler, 1969; Zeiler 1990). Others have reported on pilot-scale performance and cost of EDR compared to reverse osmosis (RO) and demonstrated the near equivalence of these two processes in terms of feasibility and projected cost (Robinson et al., 1988; Boyle Engineering, 1989).

All available information was reviewed in regard to conformity of EDR with other SDWA BAT requirements. Compatibility of EDR with other technologies, feasibility, ability to achieve compliance at a reasonable cost and commercial availability of EDR are equivalent to RO, another BAT for many inorganics. In addition, electrodialysis has a history of performance in the water supply and industrial waste treatment fields (about 25 years). As with RO, EDR is more economically applied where raw water is moderately brackish, i.e., 500 to 2,000 ppm dissolved solids, which is fairly common in the southern, central, and western United States.

Cost analyses provided by the commenter and those published by others (OTA, 1988; JAWWA, 1989; Burros, 1989; Dykes and Conlon, 1989; Conlon and McClellan, 1989) indicate the cost feasibility of applying EDR and RO for general desalting and for removal of specific contaminants from water supplies. Production costs are in the range of \$1.00 to \$2.50 per 1,000 gallons, including amortized capital and operations and maintenance, for 1 to 10 MGD plants. Waste disposal via deep well injection would be in the range of \$0.20 to \$0.30 per 1,000 gallons.

EPA estimated electrodialysis waste treatment/disposal costs in the September 1986 waste T&C documents (EPA, 1986). Waste disposal options and

design and cost criteria for EDR were assumed to be equivalent to those for RO, leading to identical cost curves. EDR and RO water treatment costs could also be assumed to be equivalent: EDR capital costs tend to be lower than RO, but the consumption of electrical power to run an EDR plant offsets the total production costs to the point of nearly equalizing the overall cost of applying the two technologies.

There should be no substantial changes to the final regulatory impact analysis (RIA) as a result of a new BAT (i.e., EDR) in the final rule because (1) water production and waste treatment costs for RO and EDR are nearly equivalent and (2) a relatively small percentage, about 5 percent, of systems estimated by the RIA would use RO to comply with an MCL.

Other technology related issues were raised in response to the proposal. Each comment is fully addressed by EPA in the Comment/Response document; however, a brief overview of comments and EPA responses is provided below.

One commenter noted the "limited capability" or effectiveness of lime softening in removing selenium, and of ion exchange (IE) and RO in removing nitrates from water. EPA refers to the T & C documents (one for each of the inorganic contaminants, as cited in the proposal) which bring together all treatment data available at the time of document preparation, and which to a great extent form the basis of EPA's BAT determinations in regard to treatment efficiency.

One commenter questioned the practicality of RO and IE technologies due to the wastes generated and the attendant difficulties related to waste disposal. As referenced in the above EPA response regarding EDR as a BAT, EPA and others have studied and documented the costs related to the treatment and disposal of water treatment waste by-products. The same referenced literature discusses waste disposal options and the site-specific nature of available options. In EPA's view, RO and IE are clearly practical technologies and, in some cases, the technologies of choice due to their ability to soften, desalt, or otherwise demineralize water intended for potable supply. The historical usage of RO membranes to treat municipal water supplies in Florida, and the application of ion exchange resins to soften water in the Midwest, are rather substantial. Arguments that these technologies are not impractical. Waste management is, however, a concern and is recognized as an integral part of water treatment. It will take a significant portion of the resources available in the planning

and management of public water systems (PWSs).

Three commenters suggested that pretreatment costs should be factored into EPA's cost estimates, because pretreatment could double the cost of treating water at very small PWSs. One of the comments specifically addressed potential problems in removing nitrate from surface water supplies. EPA responds that adding pretreatment costs would be unnecessary in most cases because existing supplies would presumably already have been treating water contaminated with high levels of turbidity, sulfate, iron, or other fouling, or competing agents that would impede RO and IE efficiencies. EPA generally assesses technologies under relatively clean source water conditions to determine BATs. However, EPA agrees with the commenter's assessment of pretreatment costs: with pretreatment added, very small installations would cost approximately twice as much as with the IE or RO alone. Medium-sized systems would cost approximately 30 percent more with pretreatment added onto the IE or RO treatment.

The issue of compliance cost for each BAT for the inorganics received additional scrutiny by EPA. In September 1989, EPA revised flow assumptions to calculate all inorganic technology costs ("Analysis of Flow Data," Michael D. Cummings, EPA-ODW/TSD, October 1987).

Based on a re-analysis of the original flow models for systems in the smallest flow category, EPA now estimates these systems would on the average be designed to deliver 24,000 gallons per day but would only be required to provide 5,600 gallons per day. The net effect of these changes is to greatly increase the cost to remove each inorganic contaminant per gallon of water delivered.

For example, the removal of chromium using two-bed ion exchange treatment in a water system serving 25-100 people was estimated in the May 22, 1989 proposal (FR 22106) as \$3.40/1,000 gallons. As a result of updating the flow assumptions, the cost of water treatment and waste disposal for chromium is now estimated at \$10.16/1,000 gallons.

Consequently, with the changes noted above (i.e., regarding electro dialysis reversal), the BATs are promulgated as proposed.

b. Synthetic Organic Contaminants. In the 1986 SDWA amendments, Congress specified in section 141(p)(5) that "Granular activated carbon is feasible for the control of synthetic organic chemicals, and any technology, treatment technique, or other means found to be the best available for the

control of synthetic organic chemicals must be at least as effective in controlling synthetic organic chemicals as granular activated carbon."

The following discussion addresses the major concerns expressed in the public comment period regarding the proposed rule published May 22, 1989. Table 7 lists the BATs for the SOC. As discussed below, the BAT for each SOC in today's rule is unchanged from the May 1989 proposal.

(1) Why PTA Is BAT for Air Stripping

Several types of aeration technology are useful for stripping volatiles from water. Packed columns or towers have been more widely studied and used to reduce the compounds at the levels that occur in drinking water. Diffused aeration has been shown to effect removal of certain SOC and may have some advantages under hydraulic or space constraints. Other aeration methods such as slat tray, spray, and airlift pumping have shown good removals in certain applications for volatile organics. In all cases, results vary depending on physical, chemical, and design factors. Packed column aeration appears to be the most efficient method in terms of gas transfer, and may also lend itself better to emissions controls than would other aeration methods. EPA considers PTA the best of the aeration treatments, thus its designation as BAT. A utility is free to choose any method, however, BAT or other, to reduce a contaminant to the MCL as long as it performs adequately.

(2) PTA and Air Emissions

EPA received five comments expressing concern that emissions from PTA facilities were simply transferring the chemical and the risk from the water to the air. In the preamble to the proposed rule, EPA addressed this concern for two carcinogenic compounds—EDB and DBCP. By modeling the risks to populations downwind from a packed tower aeration facility, "it was apparent in the cases examined that the risk resulting from exposure to EDB or DBCP by inhalation is several orders of magnitude lower than that resulting from drinking the contaminated water, and that the amount of EDB or DBCP added to the air did not significantly increase risks from airborne contaminants." The maximum individual lifetime risks ranged from 10^{-6} to 10^{-9} for inhalation and 10^{-3} to 10^{-6} for drinking the same level. There was at least three orders of magnitude difference for any scenario examined comparing ingestion to inhalation, as

depicted in table 26 of the May 22, 1989 proposal.

However, since several States regulate emissions from PTA facilities, EPA is providing a table of costs for emission controls on PTA units by the use of vapor phase carbon. Table 20 presents the costs for different compounds based upon a matrix of combinations for ease of stripping and the adsorbability of the compound. These costs are in addition to the cost of the packed tower stripping itself.

TABLE 20.—ADDITIONAL COSTS FOR VAPOR PHASE CARBON EMISSION CONTROLS FOR PACKED TOWER AERATION FACILITY

	Additional cost over PTA treatment cents/1,000 gallons		
	Small system	Medium system	Large system
Good Strippability (40:0): ^a			
cis-1,2-Dichloroethylene ^b	270	15	13
trans-1,2-Dichloroethylene ^b	270	15	13
Ethylbenzene ^b	270	11	9
Monochlorobenzene ^b	270	11	9
Tetrachloroethylene ^b	270	11	9
Toluene ^b	270	11	9
Xylenes ^b	270	11	9
Average Strippability (120:1): ^a			
1,2-Dichloropropane ^b	350	22	18
o-Dichlorobenzene ^b	340	16	11
Styrene ^b	340	16	11
Difficult Strippability (200:1): ^a			
EDB ^b	390	29	22
DBCP ^b	390	26	19

^a Poor vapor phase carbon adsorbability.

^b Moderate vapor phase carbon adsorbability.

^c Strong vapor phase carbon adsorbability.

^d Air/water ratio.

Source: Malcolm Pirnie, Inc. Memorandum to Dave Huber, U.S. EPA, February 26, 1990.

(3) BAT Field Evaluations

EPA received 14 comments that the SDWA requires field testing, not just laboratory testing, of the applicability of a technology to specific compounds before the technology can be designated "best available" to achieve the MCL. The SDWA directs EPA to set the MCL as close to the MCLG as "feasible." The SDWA defines "feasible" as "feasible with the use of the best technology . . . which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, [is] available (taking costs into consideration)." Section 1412(b)(3)(D). EPA interprets this provision to require field trials for a

technology, not for the application of that technology to each individual contaminant. Consequently, EPA has not required full-scale field validation of a technology's feasibility for treating a specific contaminant if its effectiveness has been demonstrated at bench or pilot scale for that compound. The technology, however, must reasonably be expected to perform in a similar manner under field conditions regardless of aberrations due to scale-up factors.

(4) Carbon Disposal Costs

Four commenters were concerned that the cost of disposal of spent carbon was not taken into account in the costing assumptions for the design and O&M for a facility. The cost of carbon "disposal" is essentially the cost of regenerating the spent carbon (and replacing the 12 to 15 percent lost in the process). For plants whose daily carbon use is less than 1,000 pounds per day, EPA assumes that the carbon would be regenerated off-site by the carbon supplier and that cost is included in the cost of replacement carbon. For plants whose carbon demand is more than 1,000 pounds per day, it is generally economical to regenerate on-site. The cost of the incinerator used to regenerate the carbon and its operation and maintenance costs are part of the facility capital and O&M costs already factored into total costs. The revised model that EPA now uses in developing costs (Adams and Clark, AWWA, Jan. 1988) factors into total costs the expense of carbon regeneration and replacement.

When powdered activated carbon (PAC) is used, it is usually disposed of with the alum sludge in a sanitary landfill. Commenters expressed some concern over the disposal costs should the carbon prove to be a hazardous waste. Because this rule does not consider PAC to be BAT, EPA is not addressing the issue of PAC costs, including the costs of disposal.

(5) Powdered Activated Carbon as BAT

Five commenters suggested that PAC be considered BAT since it can be used for removal of pesticide contamination in surface waters and is the same substance as GAC. EPA's position is that the use of PAC may be an appropriate choice of technology in certain instances. PAC treatment of surface water that is only intermittently contaminated by pesticides or other SOC's could be both economical, in combination with an existing filtration plant, and effective.

While PAC has proven effective in taste and odor control, its efficacy for trace SOC removal in drinking water is

variable due to factors such as carbon particle size, background organics, and plant efficiency. If application of PAC will reduce the contaminant below the MCL, it may be used in lieu of another less cost effective technology, even if the latter is BAT.

(6) Empty Bed Contact Time

EPA received one comment suggesting the 7.5-minute design empty bed contact time (EBCT) for GAC plants was shorter than the times recommended by several experts, including EPA's Adams and Clark (AWWA, Jan. 1988). EPA has used the 7.5-minute contact time because multiplying it by the ratio of design to average flows results in at least a 15-minute contact time for all but the largest three systems, where 11.9 minutes was the lowest average. A 15-minute average contact time strikes a balance between the lower carbon usage rates obtainable with longer contact times and the higher capital costs necessary to obtain the longer contact times by increasing contractor size. Long contact times also increase the preloading of natural organics which may actually increase carbon usage rates somewhat. The model, which was used to develop costs in the proposal, considered cost for EBCTs of 7.5 and 12.5 minutes. A 7.5-minute design EBCT was selected for the proposal as a reasonable time, based upon peer review.

However, based on this comment and the study by Adams and Clark (AWWA, 1988), EPA decided to revise the contact time. The EBCT was revised to 10 minutes at design flow using the Adams and Clark model, which provide a more complete and accurate estimate of costs. The 10-minute contact time at design flow resulted in average flows above 15 minutes for all 12 system size, and three minutes shorter at the 90 percentile level. Designing a 12-minute contact time for a 90 percentile flow rate for each system size resulted in very short design contact time for the smaller systems.

GAC costs as presented in Table 21 of today's rule increased from those presented in Table 27 of the proposal as a result of (1) differences in the cost equations between the CWC model used in the proposal and the Adams and Clark model used in this rule; (2) the costs for carbon storage labor and water requirements for on-site carbon transport were included in the revised costs; and (3) the design EBCT in the revised costs was 10 minutes, which required a larger facility, resulting in larger capital costs, than did the 7.5-minute EBCT in the proposal. The

increases ranged from \$2 to \$6/household/year (a 25 to 75 percent increase) for large systems to \$300 to \$310/household/year (a 46 to 55 percent increase) for smaller systems. It is significant that differences between models, rather than the increase in EBCT, caused most of the cost increase. In calculations for 0.1 and 0.45 lb/1,000 gal carbon usage rates, the differences between models resulted in total production cost increases of 21 to 44 percent for large systems and 38 to 53 percent for small systems. However, changing the contact time alone from 7.5 to 10 minutes resulted in only a change of 12 percent for large systems and 5 percent for small systems.

(7) Carbon Usage Rates

Two commenters pointed out that due to the presence of background organics the carbon usage rate (CUR) obtained from distilled water isotherm data is smaller than that obtained from full-scale testing with natural water. The concern was that costs of carbon replacement and regeneration would be much higher in actual practice than those calculated in theory using the lower CUR. The mass transfer model EPA used to develop CURs was the constant pattern homogeneous surface diffusion model, which uses distilled water isotherm parameters and kinetic coefficients determined using literature correlations.

Section 4 of the T & C document lists CURs adjusted for background organics in natural waters by using an adjustment coefficient derived from a linear regression of data points. This adjustment reflects a ratio of field to model CUR as a function of model CUR. This coefficient was developed after the May 22, 1989 proposal and improves the utility of the model. This improved model is used as the basis for the costs in today's rule.

EPA is aware that the correlation between costs and CURs is not as good for the well-adsorbed compounds such as the pesticides, typically with low CURs. Additional field data are needed in this area. However, costs are very insensitive to changes in the CURs of 0.5–0.1 lb/1,000 gallons. Most of the pesticides in question have low CURs. Adams and Clark (1989) observed that "there is only a small gradual increase in cost between a two-year and a six-month reactivation frequency." Therefore, even though more data would be useful, EPA believes that over-

costs for removal of the well-adsorbed compounds would not be greatly affected, if at all. Because the prediction is only as good as the uniformity of the water, the effect of the organic matrix on the carbon will change as the matrix changes in the influent water, despite accurate scale-ups at specific points in time. GAC adsorption behavior, and therefore the CUR, typically varies among different water matrices with the same contaminant and operating conditions. For the well-absorbed compounds, longer contact times and higher costs typically result from the impact on CURs due to the adsorption sites deeper in the bed being occupied by natural organics that interfere with SOC adsorption.

5. Determination of MCLs (Feasibility and Cost)

EPA proposed MCLs for 38 chemicals based upon an analysis of several factors, including:

(1) The effectiveness of BAT in reducing contaminant levels from influent concentrations to the MCLG.
(2) The feasibility (including costs) of applying BAT. EPA considered the availability of the technology and the costs of installation and operation for large systems (serving more than 100,000 people).

(3) The performance of available analytical methods as reflected in the PQL for each contaminant. In order to ensure the precision and accuracy of analytical measurement of contaminants at the MCL, the MCL is set at a level no lower than the PQL.

After taking into account the above factors, EPA then considered the risks at the MCL level for the EPA Group A and B carcinogens to determine whether they would be adequately protective of public health. EPA considers a target risk range of 10^{-4} to 10^{-6} to be safe and protective of public health when calculated by the conservative linear multistage model. The factors EPA used in its analysis are summarized in tables 22 and 23 for the Category I and Category II and III contaminants, respectively.

a. Inorganic Contaminant MCLs. The MCLs for the inorganic contaminants promulgated today are at the same level as those proposed in May 1986 (see table 1). EPA is reproposing the MCL for barium due to changes in the MCLG. The MCL for each inorganic contaminant is also at the same level as the promulgated MCLG for each

contaminant. EPA has determined that each inorganic MCL has one or more BATs to reduce contaminant levels to the MCLG, and that the BAT(s) is feasible (as defined by the Act), analytical methodologies are available to ensure accurate and precise measurement for each MCL, and each MCL adequately protects public health. Consequently, the MCLs (except for barium) are promulgated as proposed.

b. Synthetic Organic Contaminant MCLs

(1) Category I Contaminants

EPA considered the same factors in determining the proposed MCLs for Category I contaminants as for Category II and III contaminants. However, the proposed MCLGs for Category I contaminants are zero, a level that by definition is not "feasible" because no analytical method is capable of determining whether a contaminant level is zero. The lowest level that can be reliably measured is the PQL. As described above, EPA calculated PQLs for the SOCs based on WS studies 20–25.

In most cases, the PQL is identical to that proposed in May 1989. In the case of toxaphene, EPA lowered the PQL based upon the WS studies. The MCL for toxaphene is changed from 0.005 to 0.003 mg/l. Results of WS studies 20–25 indicate that the PQL for pentachlorophenol should be set at 0.001 mg/l rather than the proposed 0.0001 mg/l level. Consequently, EPA is reproposing the MCL for pentachlorophenol at the revised PQL. This issue is discussed more fully elsewhere in today's Federal Register reproposing the pentachlorophenol MCL. Because the PQL for toxaphene represents the lowest level feasible, EPA is promulgating this MCL at a level equal to the PQL.

In the May proposal, EPA estimated the PQL for EDB as five times the MDL. Results of WS studies 22–25 confirm that EDB can reliably be detected at 0.00005 mg/l. Consequently, the MCL is promulgated as proposed.

EPA also calculated the per capita costs for large systems to remove the SOC contaminants to or below the MCL using GAC or PTA. These costs range from \$10.00 to \$44.00 per household per year. EPA believes these costs are reasonable and promulgates the MCLs at the levels listed in Table 22.

TABLE 21.—GAC AND PACKED COLUMN COSTS TO REMOVE SOCS

[\$./household, year]¹

Compound	Carbon usage rate ²	GAC			PTA			Percent removal ³
		Small ⁴	Medium ⁴	Large ⁴	Small ⁴	Medium ⁴	Large ⁴	
Volatile SOCs:								
cis-1,2-Dichloroethylene	0.3966	\$950	\$76	\$19	\$140	\$11	\$7	90
Dibromochloropropene (DBCP) .....	.0448	910	96	10	325	60	41	90
o-Dichlorobenzene .....	.1234	930	51	15	325	60	41	90
1,2-Dichloropropane .....	.2867	930	51	14	190	17	12	93
Ethylbenzene .....	.1637	930	51	14	140	10	7	93
Ethylene dibromide (EDB) .....	.1453	930	51	14	210	23	16	90
Monochlorobenzene .....	.1930	930	51	14	150	12	8	90
Styrene .....	.0605	910	36	10	160	13	9	90
Tetrachloroethylene .....	.1144	930	51	14	130	9	6	90
Toluene .....	.3050	950	76	19	150	12	8	96.7
trans-1,2-Dichloroethylene .....	.3793	950	76	19	130	9	6	90
Xylenes:								
m-Xylene .....	.2148	930	51	14	140	10	7	90
o-Xylene .....	.3619	950	76	19	140	10	7	90
p-Xylene .....	.3718	950	76	19	140	10	7	90
Non-Volatile SOCs:								
Alachlor .....	.0371	910	36	10	N/A			
Aldicarb (sulfonate & sulfone) .....	.1032	930	51	14	N/A			
Atrazine .....	.0543	910	29	10	N/A			
Carbofuran .....	.0570	910	36	10	N/A			
Chlordane .....	.0379	910	36	10	N/A			
2,4-D .....	.1224	930	51	14	N/A			
Heptachlor .....	.0556	910	36	10	N/A			
Heptachlor epoxide .....	.0271	910	36	10	N/A			
Lindane .....	.0203	910	36	10	N/A			
Methoxychlor .....	.2137	910	51	14	N/A			
PCBs .....	.0222	910	36	10	N/A			
Pentachlorophenol .....	.0883	910	36	10	N/A			
Toxaphene .....	.0432	910	36	10	N/A			
2,4,5-TP (Silver) .....	.0813	910	36	10	N/A			

¹ Costs include amortized capital and annual operation and maintenance.² Percent removals from maximum influent levels to at or below the MCL.³ (With background TOC) Table 4-5, Technology and Cost document.⁴ Small systems serve 25-100 persons; medium systems serve 10,000 to 25,000 persons; large systems serve greater than 1,000,000. Cost in \$./household/year. Production in cents/1,000 gallons is equal to dollars per household per year (i.e., 8 ct./1,000 gallons = \$8.00/household per year).

TABLE 22.—MCL ANALYSIS FOR CATEGORY I SOCS

SOC contaminant	MCLG ¹ (mg/l)	MCL (mg/l)	PQL (mg/l)	Annual household costs using BAT ²		10 ⁻⁴ risk level (mg/l)	Notes
				GAC	PTA		
Alachlor	0	0.002	0.002	\$10.00		0.04	MCL is 1.25 x 10 ⁻⁴ risk.
Chlordane	0	.002	.002	10.00		.003	
Dibromochloropropene (DBCP)	0	.0002	.0002	10.00	\$41.00	.003	
1,2-Dichloropropane	0	.005	.005	14.00	17.00	.05	
Ethylene dibromide (EDB)	0	.00005	.00005	14.00	16.00	0.00004	
Heptachlor	0	.0004	.0004	10.00		0.0006	
Heptachlor epoxide	0	.0002	.0002	10.00		0.0004	
Pentachlorophenol ³	0	.001	.001	10.00		0.03	
Polychlorinated biphenyls	0	.0005	.0005	10.00		0.0005	
Tetrachloroethylene	0	.065	.065	14.00	9.00	0.07	
Toxaphene	0	.003	.003	10.00		0.003	

¹ EPA policy is that for all Category I contaminants the MCLG is zero.² For large surface systems serving > 1,000,000 people.³ Proposed MCLG and MCL level. EPA intends to promulgate a final MCL by July 1991.

(2) Category II and III Contaminants

For the Category II and III contaminants listed in table 23, each of the MCLs was proposed equal to its proposed MCLG. Because MCLGs for methoxychlor, styrene, and toluene changed from the levels proposed in May 1989, as discussed above, the MCLs also changed. The MCL for methoxychlor changed from 0.4 to 0.04

mg/l; styrene changed from 0.005/0.1 to 0.1; and toluene changed from 2 to 1 mg/l. Each changed MCL is based on a reassessment of the health data as discussed above.

Although PQLs for 2,4-D, methoxychlor, and 2,4,5-TP change from the levels listed in the May 1989 proposal, each is below the MCLs promulgated today and, consequently, does not impact these MCLs.

Section 1412 of the SDWA requires EPA to set MCLs as close to the MCLGs as is feasible (taking costs into consideration). EPA believes that it is feasible to set the MCLs at the MCLGs because (1) the PQL for each contaminant is at or below the level established by the MCLG; (2) BAT can remove each contaminant to a level equal to or below the MCLG; and (3) the annual household cost to install BAT in

large systems is a maximum of \$19.00 per household per year and generally

around or below \$10.00 per household per year. EPA believes that these costs

are affordable for large systems.

TABLE 23.—MCL ANALYSIS FOR CATEGORY II AND III SOCS

SOC contaminant	MCLG (mg/l)	MCL (mg/l)	POL (mg/l)	Annual household costs using BAT ¹	
				GAC	PTA
Aldicarb ²	0.001	0.003	0.003	\$10.00	
Aldicarb sulfonate ²	.001	.003	.003	14.00	
Aldicarb sulfone ²	.002	.003	.003	14.00	
Atrazine	.003	.003	.001	10.00	
Carbofuran	.04	.04	.007	10.00	
n-Dichlorobenzene	.6	.6	.005	14.00	\$4.00
cis-1,2-Dichloroethylene	.07	.07	.005	19.00	7.00
trans-1,2-Dichloroethylene	.1	.1	.005	19.00	6.00
2,4-D	.07	.07	.001	14.00	
Ethylbenzene	.7	.7	.005	14.00	
Lindane	.0002	.0002	.0002	10.00	
Methoxychlor	.04	.04	.001	14.00	
Monochlorobenzene	.1	.1	.005	14.00	7.00
Styrene	.1	.1	.005	10.00	9.00
Toluene	1	1	.005	19.00	8.00
2,4,5-TP (Silver)	.05	.05	.005	13.00	
Xylenes (total)	10	10	.005	19.00	6.00

¹ For large surface systems serving > 1,000,000 people.

² Proposed MCLG and MCL levels. EPA intends to promulgate final levels by July 1991.

C. Treatment Technique Requirements

The principle sources of acrylamide, epichlorohydrin, and styrene in drinking water are impurities in water treatment chemicals and surfaces in contact with drinking water.

Because no standardized analytical methods are available for acrylamide and epichlorohydrin at low levels in drinking water, EPA proposed a treatment technique for acrylamide and epichlorohydrin and provided guidance for styrene.

EPA proposed to limit the allowable monomer levels in products used during water treatment, storage, and distribution. These levels are:

Acrylamide: 0.05 percent acrylamide in polyacrylamide dosed at 1 ppm.

Epichlorohydrin: 0.01 percent residual epichlorohydrin concentration dosed at 20 ppm.

Styrene: 1 ppm styrene in styrene copolymers used as direct additives and as resin. Also, MCLs were proposed at 0.005 mg/l (as Category I) and 0.1 mg/l (as Category II).

Under the proposed rule, a water system using a product containing acrylamide and epichlorohydrin must certify to the State that the amount of residual monomer in the polymer and the dosage rate would not cause the concentration in finished water to exceed the specified level.

Summary of Comments: EPA received 25 comments on the proposal relating to these chemicals. All but six commenters were generally supportive of the proposal. Three commenters supported the approach adopted by EPA. Among

the comments received, 22 were on acrylamide, 21 on epichlorohydrin and 5 on styrene.

Most commenters expressed concern that the language in the proposal does not clarify who does the testing for monomer—the water system or the manufacturer. It was suggested that the language state that in annual certification to the States, water systems can rely on manufacturer's certification. The commenters overwhelmingly opposed the idea of water systems performing the test for residual monomer.

Today's rule is modified to make it clear that a water system does not need to test for monomers. A water system can either test or rely on manufacturer's certification or on third-party certification, whichever mechanism the State is willing to accept.

Nine commenters suggested that the issue of monomers in treatment and distribution aids should be handled either by the States through a third-party certification program or through federal labeling requirements.

Under the SDWA, EPA can establish and enforce maximum contaminant levels or treatment requirements but does not have the authority for establishing labeling requirements for proprietary products. As stated above, a water system can either test the product or rely on the manufacturer's certification or on third-party certification (e.g., National Sanitation Foundation (NSF)), whichever mechanism the State is willing to accept.

One commenter suggested establishment of MCLs for these chemicals. Since no analytical methods (EPA-approved or otherwise) are available for analysis of low levels of acrylamide and epichlorohydrin in drinking water, however, establishment and enforcement of an MCL would be impractical. Therefore, EPA has proposed a treatment-related requirement rather than an MCL. Furthermore, EPA feels that the proposed treatment-related approach is a valuable preventive measure for drinking water contamination.

One commenter felt that there is no factual or procedural basis for regulating styrene. This commenter offered two supporting reasons: (1) Two manufacturers looked for styrene in ion exchange resins but did not find any (sensitivity of the method: 1 ppb); and (2) styrene containing polymers and copolymers are subject to the third-party certification program which should be able to ensure safety.

According to the information available to EPA, styrene is present at low levels in styrene copolymers intended for use in water treatment as a secondary direct additive. This, combined with the fact that styrene is in wide industrial use and has been found in 22 hazardous waste sites listed on the National Priority List, indicates that it can be anticipated to occur in drinking water. National Organics Reconnaissance Survey (NORS) detected styrene in the water of three of eight cities monitored.

One commenter believed epichlorohydrin should not be allowed in flocculating agents for drinking water as it is a powerful contact mutagen. With the proposed treatment requirement, nominal epichlorohydrin concentration in drinking water would be 0.0022 mg/l. The upper bound lifetime cancer risk at this concentration is calculated to be 6×10^{-7} . This is an extremely low risk considering that the use of epichlorohydrin polymers and copolymers is widespread and highly desirable because these materials are effective in removing other drinking water contaminants.

Consequently, with the modification as noted above, the treatment technique requirements for acrylamide and epichlorohydrin are promulgated as proposed. The guidance for styrene is finalized as proposed.

D. Compliance Monitoring Requirements

1. Introduction

The proposed compliance monitoring requirements (54 FR 22062) included specific monitoring requirements for inorganic contaminants (barium, chromium, cadmium, mercury, and selenium); nitrate/nitrite; asbestos; volatile organic contaminants (VOCs); and pesticides/PCBs. EPA did not propose compliance monitoring requirements for acrylamide and epichlorohydrin because adequate analytical methods did not exist for these contaminants at low levels in drinking water.

EPA proposed that all community and non-transient water systems comply with the monitoring requirements for all contaminants (except acrylamide and epichlorohydrin) because of long-term chronic exposure of these system's consumers. Transient non-community water systems were required to comply with the requirements for nitrate/nitrite only because of the acute nature of exposure of these chemicals. The compliance monitoring requirements that EPA is promulgating today are the minimum necessary to determine whether a public water supply delivers drinking water that meets the MCLs. Though MCLGs and MCLs are being repropose for aldicarb, aldicarb sulfoxide, aldicarb sulfone, barium, and pentachlorophenol, EPA anticipates these will be promulgated by July 1991. EPA believes that whatever level is promulgated for aldicarb, aldicarb sulfoxide, aldicarb sulfone, barium, and pentachlorophenol would not affect the monitoring requirements. Consequently, the requirements promulgated today also apply to aldicarb, aldicarb

sulfoxide, aldicarb sulfone, barium, and pentachlorophenol.

The monitoring requirements that are promulgated today generally follow the three-tier approach first outlined on October 5, 1983 (48 FR 45502). Nitrate is the only contaminant promulgated today that falls in Tier I. The remaining contaminants are regulated as Tier II contaminants, a status that allows States the discretion to increase or decrease monitoring based upon established criteria and site-specific conditions. Because of the low occurrence of nitrite at levels above the MCL, EPA has placed nitrite in Tier II in this rule.

In developing the compliance monitoring requirements for these contaminants, EPA considered (1) the likely source of drinking water contamination, (2) differences between ground and surface water systems, (3) how to collect samples that are representative of consumer exposure, (4) sample collection and analysis costs, (5) the use of historical monitoring data to identify vulnerable systems and subsequently specify monitoring requirements for vulnerable systems, (6) the limited occurrence of some contaminants, and (7) the need for States to tailor monitoring requirements to system- and area-specific conditions.

Although base monitoring requirements for surface and groundwater systems are the same for all contaminants (except inorganic and nitrate/nitrite), groundwater systems will qualify more frequently for reduced monitoring and return more quickly to the base monitoring requirements because (1) the sources and mechanisms of contamination for ground and surface water systems are different, (2) the overall quality of surface waters tends to change more rapidly with time than does the quality of ground waters, and (3) seasonal variations tend to affect surface waters more than ground waters. Spatial variations are more important in ground waters than in surface waters since groundwater contamination can be a localized problem confined to one or several wells within a system. Therefore, monitoring frequency is an important factor to determine baseline conditions for surface water systems, while sampling location within the system generally is more important for groundwater systems. Today's monitoring requirements generally require surface water systems to monitor at an increased frequency for longer periods than groundwater systems.

EPA monitoring requirements are designed to ensure that compliance with

the MCLs is met and to efficiently utilize State and utility resources. EPA's goal in today's rule is to ensure these monitoring requirements are consistent with monitoring requirements promulgated previously by EPA and with known occurrence trends. The monitoring requirements promulgated today focus monitoring in individual public water systems on the contaminants that are likely to occur, an approach that includes:

- Allowing States to reduce monitoring frequencies based upon system vulnerability assessments for the SOC's (VOCs and pesticides/PCBs) listed in § 141.61(a) and (c) and for asbestos.
- Allowing States to target monitoring to those systems that are vulnerable to a particular contaminant.
- Allowing the use of recent monitoring data in lieu of new data if the system has conducted a monitoring program generally consistent with today's requirements and using reliable analytical methods.
- Encouraging the States to use historical monitoring data meeting specified quality requirements and other available records to make decisions regarding a system's vulnerability.
- Requiring all systems to conduct repeat monitoring unless they demonstrate through an assessment or other data that they are not vulnerable.
- Designating sampling locations and frequencies that permit simultaneous monitoring for all regulated source-related contaminants, whenever possible.
- Elsewhere today in the Federal Register EPA is proposing changes to the monitoring frequencies that were promulgated July 8, 1987 for eight VOCs. This change, when final, will require all VOC sample collection for the 10 VOCs in this rule and the eight VOCs in the July 8, 1987 rule to occur at the same time.

2. Effective Date

In the May 22, 1989 Federal Register Notice, EPA proposed to promulgate the monitoring requirements under section 1445 within 30 days of promulgation because section 1445 imposes no limitations on when monitoring requirements would be effective. After 18 months, the compliance monitoring requirements would be effective under section 1412. The MCLs and other requirements would continue to be promulgated under section 1412 and effective in 18 months.

Most commenters did not support making the requirements effective within 30 days citing the confusion

between "new" and "old" regulatory requirements. Other commenters cited the lack of laboratory capacity for new analytical methods. These commenters stated that laboratories frequently do not invest in capital equipment until the rules are promulgated; consequently, the 18-month lead time before analysis must be conducted is necessary. Most States cited their inability to adopt regulations in less than 18 months and pointed out that if they did not adopt regulations by the effective date, EPA would have primacy for the "new" rule while the States would retain primacy for previous rules. The question of who retains primacy could potentially confuse water systems. One commenter indicated that promulgating monitoring requirements is beyond the intent of section 1445. Numerous commenters cited the impact on State resources to review vulnerability assessments, enforcement, reduced monitoring decisions, etc., as a rationale for allowing States sufficient time (i.e., 18 months before the monitoring requirements are effective).

After reviewing the public comments, EPA agrees that there is the potential for confusion in moving forward the effective date for monitoring. In addition, the Agency agrees that implementation problems may occur in beginning monitoring early. Consequently, in today's action EPA will promulgate the compliance monitoring requirements for regulated substances under section 1412. All monitoring requirements will be effective 18 months after promulgation. For contaminants that have existing regulatory requirements (inorganics and nitrates), the water systems must continue to comply with the existing requirements until they are superseded by the new requirements.

3. Standard Monitoring Framework

EPA received extensive comments stating that the proposed monitoring requirements are complex and would lead to confusion and misunderstanding among the public, water utilities, and State personnel. Commenters also cited the lack of coordination among various regulations. Many commenters suggested that EPA simplify, coordinate, and synchronize this regulations with previous regulations. In response to these comments, EPA has developed a standard monitoring framework to address the issues of complexity, coordination of monitoring requirements among various regulations, and synchronization of monitoring schedules. This framework will serve as a guide for future source-related monitoring requirements adopted by the

Agency. The framework was developed based on the proposed requirements, the options and requests for comments EPA discussed in the proposal, and the comments received by EPA.

EPA believes that the framework will in large measure address the comments that recommended that reducing complexity, synchronizing monitoring schedules, standardizing regulatory requirements, and giving regulatory flexibility to States and systems to manage monitoring programs. EPA believes these changes have the potential to reduce costs by combining monitoring requirements (including vulnerability assessments) for several regulations on the same schedule and promote greater voluntary compliance by simplified and standardized monitoring requirements.

This framework will first be used in today's regulation. EPA intends to apply this framework to future requirements for source-related contamination (i.e., VOCs, inorganics, pesticides, and radionuclides).

Use of the framework envisions a cooperative effort between EPA and States. The monitoring requirements promulgated today are the minimum federal requirements necessary to ascertain systems' compliance with the MCLs. In some cases, States will increase the monitoring frequencies above the federal minimums to address site-specific conditions.

For all contaminants contained in today's rule, minimum (or base) monitoring requirements may be increased or decreased by States based upon prior analytical results and/or the results of a vulnerability assessment. The monitoring requirements outlined today follow to a large extent the requirements proposed on May 22, 1989. In the May proposal EPA stated as a goal to efficiently utilize State and utility resources and be consistent with monitoring requirements previously promulgated by EPA. EPA believes that today's requirements meet that goal.

a. Three-, Six-, and Nine-Year Cycles. In order to standardize monitoring cycles in this regulation (and in future regulations), EPA is establishing nine-year compliance cycles. Each nine-year compliance cycle consists of 3 three-year compliance periods. All compliance cycles and periods run on a calendar year basis (i.e., January 1 to December 31). This regulation establishes the first nine-year compliance cycle beginning January 1, 1993 and ending December 31, 2001; the second cycle beginning January 1, 2002 and ending December 31, 2010; etc. (see § 141.2—Definitions). Within the first nine-year compliance cycle

(1993 to 2001), the first compliance period begins January 1, 1993 and ends December 31, 1995; the second begins January 1, 1996 and ends December 31, 1998; and the third begins January 1, 1999 and ends December 31, 2001. EPA in this regulation is also requiring that initial monitoring (defined as the first full three-year compliance period beginning 18 months after the promulgation date of a rule) must begin in the first full compliance period after the effective date. For today's regulation, the effective date is July 30, 1992. Since the next full three-year compliance period begins January 1, 1993, the initial monitoring period for today's regulation occurs in the compliance period 1993–1995.

b. Base Monitoring Requirements. In order to standardize the monitoring requirements, EPA has established base (or minimum) monitoring frequencies for all systems at each sampling point. These base monitoring frequencies apply to all community and non-transient water systems. In cases of detection or non-compliance, EPA has specified increased monitoring frequencies from the base. These increases are explained below. Systems will also be able to decrease monitoring frequencies from the base requirements by obtaining waivers from the State where a State permits such waivers. Decreases from base monitoring requirements through waivers are discussed in general under the section on decreased monitoring and in the discussion of monitoring frequency for each class of contaminants.

In most cases, these increased or decreased frequencies in most cases are similar to the frequencies proposed in May 1989. Specific changes are discussed below under each contaminant group.

Inorganic contaminant base requirements are the same as proposed—one sample at each sampling point every three years for groundwater systems and annually for surface water systems. Modification of base requirements for VOCs is discussed below in the section on VOC monitoring frequency.

For asbestos and pesticides, EPA proposed that monitoring was not required unless the State determined that the system was vulnerable based upon a State-conducted assessment. States were required to complete all assessments within 18 months of promulgation. If the State determine that a system was vulnerable to pesticides/PCBs, systems were required to monitor on a three- or five-year schedule depending upon system size

and whether contaminants were detected. For systems vulnerable to asbestos contamination, repeat monitoring frequencies for asbestos of every three years generally were required based upon ground/surface water distinctions and the analytical result of the initial sample.

The May 1989 notice also included an alternative monitoring scheme which would require all CWSs and non-transient, non-community water systems (NTWSs) to monitor for asbestos and pesticides/PCBs at specified (base) frequencies. Most comments EPA received opposed a round of initial monitoring by all systems. These commenters cited the lack of occurrence of pesticides/PCBs in drinking water and the expense of monitoring, particularly for asbestos. Several commenters questioned the availability of sufficient laboratory capacity.

According to the proposed rule, if States did not conduct a vulnerability assessment for any one of the 80,000 water systems within 18 months and determine system vulnerability, then the system was deemed to be not vulnerable and would not be required to monitor. EPA's evaluation of the comments revealed that States, in particular, believed that their ability to conduct all vulnerability assessments within 18 months would be limited because of resource constraints on funds and staff. Most States that commented cited this resource shortfall as a major impediment.

After reviewing and evaluating the comments, EPA is adopting the alternative monitoring approach discussed in the proposal for asbestos, pesticides/PCBs, and unregulated contaminants. EPA is making this change for several reasons. First, EPA believes requiring all systems to monitor for pesticides/PCBs and asbestos is more protective of health because systems will be required to monitor if a vulnerability assessment is not conducted. Second, after reviewing the comments, EPA believes that the proposed rule was deficient in not considering the inability of States to conduct vulnerability assessments within 18 months. This change in today's rule creates an enforceable requirement. Finally, EPA believes the impact of requiring a system to monitor for a particular contaminant or not, is the same under the proposed scheme and today's requirements—provided a vulnerability assessment is conducted and a waiver is granted.

EPA has combined the above change with the provision that systems may conduct the vulnerability assessment and, at the State's discretion, obtain a

waiver (see waiver discussion below). EPA has shifted the responsibility to conduct vulnerability assessments from States to systems because the vulnerability assessment is a monitoring activity that historically has been a system responsibility. Each individual system can decide whether to conduct a vulnerability assessment (rather than monitor) based on cost, previous monitoring history, and coordination with other vulnerability type assessments (i.e., sanitary surveys, Wellhead Protection Assessments). In addition, because of States' indicated resource shortfalls, vulnerability assessments would not occur in many States. Though EPA permits systems to conduct vulnerability assessments, approval of waivers based on those vulnerability assessments rests with the States. EPA believes the changes outlined above address, in part, the State resource issue and will result in an enforceable drinking water standard.

In addition, EPA has simplified the waiver procedures to more fully apply to situations involving pesticides (see the discussion of waivers below). The changes outlined above will allow all systems to apply for a waiver from the monitoring requirements where States provide for such waivers. Based on limited occurrence data, EPA anticipates that most systems should be granted a waiver for most pesticides, asbestos, and unregulated contaminants. In cases where a system is not granted a waiver by the State, it will be required to monitor at the specified base frequency. Consequently, for the reasons specified above, all systems will be required to monitor for all pesticides/PCBs, asbestos, and unregulated contaminants with an opportunity for reduced monitoring based upon an assessment.

c. Eight VOCs Regulated July 8, 1987. In order to standardize the monitoring requirements for all VOCs, the repeat monitoring frequencies promulgated for the eight VOCs (July 8, 1987 rule) are being proposed elsewhere in today's Federal Register so that the requirements in today's rule will be identical for all 18 VOCs. EPA intends to promulgate a final rule for the eight VOCs by July, 1991. EPA is proposing this change so a system that has completed unregulated VOC monitoring can monitor for all 18 VOCs using today's increased or decreased repeat monitoring criteria beginning in January 1993.

d. Increased Monitoring. Although it is not possible to standardize requirements for all contaminants, EPA in this final rule seeks to standardize the criteria that require a system to increase monitoring from the base requirements

and that allow the system to return to the base requirement. In general, today's rule requires monitoring frequencies to increase when a contaminant is measured at a certain concentration. These concentrations are specified in federal rules, and vary by class or toxicity of the contaminant. In today's rule, these "trigger" concentrations are set variously at the MCL, 50 percent of the MCL, or the detection limit of the analytical method used to measure the contaminant. Specifically, the trigger concentrations are (1) 0.5 mg/l for nitrite, 5 mg/l for nitrate, and 5 mg/l for nitrate/nitrite combined (each of which is 50 percent of the MCL); (2) the MCLs for asbestos and five other inorganic contaminants; and (3) the analytical detection limits for VOCs, PCBs, and pesticides. The detection limit for each VOC is 0.0005 mg/l. The PCBs and pesticides detection limits are given in Table 24. The rationale for varying the detection limits for increased monitoring is addressed in each section for the contaminant monitoring frequencies below.

After exceeding the trigger concentration for each contaminant, systems must immediately increase monitoring to quarterly (beginning in the subsequent quarter after detection) to establish a baseline of analytical results. Groundwater systems are required to take a minimum of two samples and surface water systems must take four samples before the State may permit less frequent monitoring. EPA is requiring surface water systems to take a minimum of four samples (rather than two for groundwater systems) because surface water is generally more variable than ground water and, consequently, additional sampling is required to determine that the system is "reliably and consistently" below the MCL. Today's rule allows a State, after a baseline is established, to reduce the quarterly monitoring frequency if the system is "reliably and consistently" below the MCL. "Reliably and consistently" means that the State has enough confidence that future sampling results will be sufficiently below the MCL to justify reducing the quarterly monitoring frequency. Systems with widely varying analytical results or analytical results that are just below the MCL would not meet this criterion. In all cases, the system remains on a quarterly sampling frequency until the State determines that the system is "reliably and consistently" below the MCL. EPA is adopting this approach based on comments received on the proposed rule that suggested the EPA allow States to modify the monitoring schedules in

those systems which are less than the MCL. EPA believes this approach will result in consistency among the regulatory requirements for the different classes of contaminants.

In the proposal, EPA required a minimum of 12 quarters before the State could reduce the monitoring frequency. Several commenters suggested that a minimum of 12 quarters after monitoring had been increased by a trigger level was too long. These commenters suggested that EPA should require sufficient monitoring to establish a baseline. As noted, EPA believes that the minimum number of samples necessary to establish a baseline is two for groundwater systems and four for surface water systems. EPA is adopting this approach because the Agency agrees with commenters who pointed out that systems whose analytical results remain below the MCL do not pose a health threat.

In the May 1989 proposal, a system with any sample exceeding 50 percent of the MCL for asbestos and pesticides/PCBs would be required to take a minimum of 12 quarterly samples. If all 12 were <50 percent of the MCL, the State could reduce monitoring. Most commenters objected to the 50 percent trigger, stating it was "arbitrary" and not related to the MCL. Although EPA continues to believe that it is appropriate to require additional monitoring in cases of detection, consistent with the May proposal, the Agency has modified today's rule from that proposal to give States additional flexibility to reduce monitoring for those systems whose analytical results are "reliably and consistently less than the MCL." Systems meeting this criterion are eligible for reduced monitoring from the specified increased monitoring frequency. EPA is retaining the 50 percent trigger for increased monitoring for nitrate and nitrite because detection for nitrate/nitrite is significantly below the MCL (e.g., as low as 0.004 mg/l) and most systems would be required to increase monitoring with little benefit of increased health protection.

e. Decreased Monitoring. Systems may decrease monitoring from the base requirement by receiving a waiver from the State. State waivers may either eliminate the requirement for that compliance period (i.e., pesticides/PCBs and asbestos) or reduce the frequency (i.e., inorganics and VOCs). Waivers are either based on a review of established criteria ("a waiver by rule") or by a vulnerability assessment. In either a "waiver by rule" or "vulnerability assessment," the criteria for waiver are

specified. Each is discussed in more detail below.

All waivers must be granted on a contaminant-by-contaminant basis. However, systems and States will find it economical to apply for and grant the waivers for those contaminants that may be analyzed using the same analytical methods. For example, since measurement of pesticides or PCBs with each analytical method would cost \$800 for four quarterly samples, systems should consider doing a vulnerability assessment and applying for a waiver for all contaminants covered by a specific analytical method. This packaging of assessments and State decision making will yield significant cost savings to both systems and State primacy programs.

Waivers for the pesticides/PCBs and VOCs may be granted after the system conducts a vulnerability assessment and the State determines the system is not vulnerable based on that assessment. A waiver must be renewed during each compliance period. Waivers for asbestos, based on a vulnerability assessment, are also for three years but only need to be renewed in the first compliance period of each nine-year compliance cycle. Waivers for inorganic contaminants (except nitrate/nitrite) may be granted for up to nine years. If a system does not receive a waiver by the beginning of the year in which it is scheduled to monitor, it must complete the base monitoring requirement.

One change that EPA is adopting in § 142.92 is that EPA may rescind waivers issued by a State where the Agency determines that the State has issued a significant number of inappropriate waivers. EPA does not intend to utilize this provision except in special situations where the State has not followed its own established protocols and procedures that have been EPA-approved during the adoption of rules and procedures for this rule (see also the discussion on State primacy requirements). If a waiver is rescinded, the system must monitor in accordance with the base requirements in today's rule.

f. Vulnerability Assessments. The concept of vulnerability assessments generated considerable comment. Most commenters supported the concept of using vulnerability assessments to reduce monitoring but had questions about how to conduct the assessments. Comments ranged from requesting EPA to provide specific guidance on how to conduct an assessment to agreeing that the criteria EPA specified in the proposal were correct. EPA has decided that a detailed protocol for what is

usually a very site-specific analysis is not appropriate. Instead, EPA desires that each State develop its own specific vulnerability assessment procedures that use the general guidelines established by EPA. If a State chooses not to develop these procedures, systems cannot receive waivers and must monitor at the base requirements.

In today's rule EPA made several changes to the vulnerability assessment criteria for VOCs and pesticides/PCBs. In the proposal, EPA listed six criteria systems must consider in conducting vulnerability assessments for pesticides/PCBs: Previous analytical results; proximity of the system to sources of contamination; environmental persistence; protection of the water source; nitrate levels; and use of PCBs in equipment. For VOCs, the criteria were previous monitoring results, number of people served, proximity to a large system, proximity to commercial or industrial use, storage or disposal of VOCs, and protection of the water source.

EPA is making several changes to the vulnerability assessment criteria and the process to simplify the procedure. First, a two-step waiver procedure is available to all systems. Step #1 determines whether the contaminant was used, manufactured, stored, transported, or disposed of in the area. In the case of some contaminants an assessment of the contaminant's use in the treatment or distribution of water may also be required. "Area" is defined as the watershed area for a surface water system or the zone of influence for a groundwater system and includes effects in the distribution system. If the State determines that the contaminant was not used, manufactured, stored, transported, or disposed of in the area, then the system may obtain a "use" waiver. If the State cannot make this determination, a system may not receive a "use" waiver but may receive a "susceptibility" waiver, discussed below. Systems receiving a "use" waiver are not required to continue on to Step #2 to determine susceptibility. EPA anticipates that obtaining a "use" waiver will apply mostly to pesticides/PCBs where use can be determined more easily than for VOCs. Obtaining a "use" waiver for the VOCs will be limited because VOCs are ubiquitous in the United States. If a "use" waiver cannot be given, a system may conduct an assessment to determine susceptibility. Step #2.

Susceptibility considers prior occurrence and/or vulnerability assessment results, environmental persistence and transport of the

chemical, the extent of source protection, and Wellhead Protection Program reports. Systems with no known "susceptibility" to contamination based upon an assessment of the above criteria may be granted a waiver by the State. If "susceptibility" cannot be determined, a system is not eligible for a waiver. A system must receive a waiver by the beginning of the calendar quarter in which it is scheduled to begin monitoring. For example, if a system is scheduled to begin monitoring in the calendar quarter beginning January 1, 1993, it must receive a waiver by December 31, 1992 for reduced monitoring to apply.

Several commenters requested that EPA permit "area wide" or geographical vulnerability assessment determinations. Though EPA at this time is skeptical that "area wide" determinations can be conducted with sufficient specificity to predict contamination over a large area, EPA will allow this option when States submit their procedures for conducting vulnerability assessments determine "use" waivers.

EPA's goal is to combine vulnerability assessment activities in other drinking water programs with today's requirements to create efficiencies. EPA also desires to use the results of other regulatory program requirements, such as Wellhead Protection Assessments, to determine a system's vulnerability to VOC and pesticide/PCBs contamination. Systems and States may schedule today's assessments with sanitary surveys required under the Total Coliform Rule (54 FR 27546), watershed assessments, and other water quality inspections so that all regulatory, operational, and managerial objectives are met at the same time.

EPA intends to issue a guidance that will give flexibility to States in conducting vulnerability assessments and allow them and local public water systems to meet these and similar requirements under the Wellhead Protection Program, satisfying the requirements of both programs with one assessment. Additionally, this combined assessment approach may be used to meet similar requirements under the evolving Underground Injection Control (UIC)—Shallow Injection Well Program.

g. Relation to the Wellhead Protection (WHP) Program. The Agency planned to integrate particular elements of the Public Water System Wellhead Protection, and UIC programs related to contaminant source assessments around public water supply wells prior to receiving comments to that effect. Comments received on the proposed Phase II Rule reinforce and support this

interest. Specifically, the Agency plans to prepare a guidance document on groundwater contaminant source assessment that merges the vulnerability assessment of the PWSS program for pesticides and VOCs with the wellhead delineation and contaminant source which can be used to establish priorities of UIC wells. This integration is expected to assist State and local drinking water program managers responsible for groundwater supplies to more efficiently and effectively administer the portion of their programs addressing source protection and will be the basis for determining monitoring frequency. The guidance will give States flexibility in revising vulnerability/contaminant source assessments, a concern of several commenters.

Notably, Section 1428 of the SDWA requires each State to submit a WHP program for EPA review and approval. The implementation of WHP programs by States may be phased in to allow resources to be used most effectively. This matter can be addressed in the State WHP submittal.

When States submit WHP programs for approval in the future, program documents should address how the State will phase requirements for Wellhead Protection Areas (WHPAs) with other PWSS regulations. In some States, to be most effective, this program integration may need to be accomplished through a coordinating agreement or other mechanism among several State agencies. The guidance would allow States to tailor their program provisions to conditions in the States, within broad guidelines. Information from the other related groundwater programs (such as Superfund, RCRA) will be useful in this assessment, as pointed out by one commenter. This information also includes identification of sources not regulated under federal programs, but perhaps regulated by States, such as septic tanks. Therefore, States may be able to meet similar requirements of these three programs through following a general set of guidance procedures.

One commenter was concerned about the difficulty of delineating wellhead protection areas. A State may choose from several methods to delineate WHPAs. As long as the method is determined to be protective, a State may choose a simplified method described in "Guidelines for the Delineation of Wellhead Protection Areas" (June 1987, available from the Office of Ground-Water Protection, U.S. EPA, EPA 440/6-87-010). If a State desires more information for use in the decision-making process, it may choose more

sophisticated methods identified in the "Guidelines." EPA had made available to States and local agencies computer software and training for use of the "Guidelines" to make the process of WHPA delineation less difficult.

Additionally, one commenter was concerned about inclusion of recharge areas in WHPAs. WHPAs may incorporate recharge areas as long as they are within the jurisdiction of the agencies identified in the EPA-approved programs. However, WHPAs must meet the requirements of this rule if they are to be used to make monitoring waiver determinations. The State cannot accept a WHP program in lieu of a vulnerability assessment if the recharge area is not covered to meet all the requirements of this rule.

Once a WHPA is delineated, a State may desire to apply a range of assessment measures to define hydrogeologic vulnerability within the delineated area. A State may decide a method of assigning priorities to the public water systems based on vulnerability, size, or other criteria acceptable to EPA. While one commenter indicated that DRASTIC (one method of characterizing a hydrogeologic setting) was useful in that State for describing hydrogeologic factors affecting the physical-geologic vulnerability of an area, it does not take the place of delineating the zone of contribution to wells. Furthermore, the use and disposal of chemicals and other wastes are also factors affecting an area's vulnerability to contamination.

EPA's Office of Ground-Water Protection is developing a Comparative Risk Ranking and Screening System to help States and local water supply managers prioritize potential contaminant sources in carrying out their programs for resource protection, a concern of one commenter. This system could also be used in setting monitoring priorities but was not designed specifically for that application. As another commenter indicated, the States may use the regulatory mechanisms available to them (RCRA permits, NPDES permits) to determine the point sources of regulated, and potentially contaminating, substances in or near areas needing protection, such as wellhead and recharge areas.

One commenter believed that drought planning was more important than contingency planning for alternate sources of drinking water due to contamination by chemicals. Drought planning is very important in many locations and needs to be conducted. However, section 1428 specifically calls for contingency planning in the event of

contamination of public water wells in wellhead protection areas. Contingency planning could be integrated with drought planning, and in many locations the same sources of water may be used in either situation as alternate sources of drinking water.

One commenter was concerned about funding for both the Wellhead Protection Program and the Sole Source Aquifer Demonstration Program in Critical Aquifer Protection Areas. In fiscal year 1990, EPA is supporting State's activities in developing WHP programs. To date, 29 States have submitted documents for approval. Of these, four State wellhead protection programs have been approved at this time. It is expected that more programs will be approved by the end of the fiscal year.

With respect to the Sole Source Aquifer Demonstration Program for Critical Aquifer Protection Areas, no funding has been appropriated for this program for the period FY 1987-1990, and as a result, no such areas have been identified.

h. Initial and Repeat Base Monitoring. Initial monitoring is defined as the first full three-year compliance period that occurs after the regulation is effective. As discussed earlier, all systems must monitor at the base monitoring frequency unless a waiver is obtained. The initial monitoring period for today's regulation begins January 1, 1993 and ends December 31, 1995. After the system fulfills the initial (or first) base monitoring requirement, it must monitor at the repeat base frequency. Generally the repeat base frequency is the same as the initial monitoring frequency but in several instances the base monitoring frequency is reduced based on previous analytical results (e.g., pesticides/PCBs).

In the May 1989 proposal, for the VOCs and pesticides/PCBs, community systems serving more than 10,000 persons were required to complete all monitoring within 18 months of promulgation, systems serving 3,300 to 10,000 persons were required to complete monitoring within 30 months, and systems serving fewer than 3,300 persons were required to complete monitoring within 54 months. Non-transient water systems were required to complete all monitoring within 48 months. In today's rule EPA eliminates the phase-in of monitoring based on system size.

In today's rule, EPA requires all systems to complete initial monitoring (either by sampling or obtaining a waiver) by December 31, 1995, which is the end of the first compliance period. It is possible that this change may delay monitoring for some large systems, but

otherwise all monitoring in this rule will be completed approximately five years after promulgation rather than the four and one-half years in the May 22, 1989 proposal. Most systems will monitor sooner because today's rule does not delay completion of initial monitoring for the smallest systems (those less than 3,300) for four and one-half years. Systems serving less than 3,300 persons constitute approximately 80 percent of the regulated systems. Instead, under today's rule, EPA is requiring the States to establish a sampling schedule that will result in approximately one-third of the systems monitoring during each of the three years of a compliance period. States will have the flexibility to designate which systems must monitor each year based upon criteria such as system size, vulnerability, geographic location, and laboratory access. This change will result in earlier completion of initial monitoring for most systems. EPA believes that allowing States the discretion to schedule monitoring for each system during the compliance monitoring period will enable States to manage their drinking water programs more efficiently.

In cases where the State has not adopted regulations by January 1, 1993, and in States and on Indian lands where EPA retains primary enforcement responsibility, systems will be required to complete monitoring within 12 months after notification by EPA. In cases where States have not yet adopted regulations and EPA is the primacy agent for this regulation, EPA intends to use the priority scheme envisioned by the State to minimize the disruption to the regulated community when the State does adopt the requirements and schedules systems to monitor.

Once a system is scheduled for the first, second, or third year of a compliance period, the repeat schedule is set for future compliance periods. For example, if a system is scheduled by the State to complete the initial base requirement by the end of the first year, all subsequent repeat base monitoring for that system must be completed by the end of the first year in the appropriate three-year compliance period. This is necessary to prevent systems from monitoring in the first year of the first compliance period and the third year of the repeat base period.

4. Monitoring Frequencies

a. Inorganics (1) Initial and Repeat Base Requirements. In the May 1989 proposal, surface water systems were required to monitor annually and groundwater systems every three years. Most commenters supported that frequency. The monitoring frequencies

in today's rule are identical to these proposed frequencies. Systems will be required to take the initial base sample for each inorganic during the initial compliance period of 1993 to 1995 (subject to State scheduling). Surface water systems on annual sampling schedule are required to start in 1993.

(2) Increased Monitoring. EPA has added a requirement that systems that exceed the MCL (either in a single sample or with the average of the original and repeat sample) and which, consequently, are out of compliance, must immediately (i.e., the next calendar quarter after the sample was taken) begin monitoring quarterly. Systems must continue to monitor quarterly until the primacy agent determines that the system is "reliably and consistently" below the MCL. Groundwater systems must take a minimum of two samples and surface water systems must take a minimum of four samples after the last analytical result above the MCL, before the State can reduce monitoring frequencies back to the base requirement (i.e., annually for surface systems and every three years for groundwater systems).

EPA is promulgating this change for several reasons. First, it is consistent with the monitoring requirements contained elsewhere in this rule that more frequent monitoring occur in instances of non-compliance. Second, EPA believes that systems that are out of compliance should monitor more frequently to determine the extent of the problem. If EPA had not made this change, groundwater systems that exceed the MCL could continue to monitor every three years. EPA believes the previous frequencies for ground and surface systems were not protective of public health in those cases where systems exceeded the MCL.

(3) Decreased Monitoring. In the May 1989 Notice, EPA proposed that systems be allowed to reduce the monitoring frequency to no less than 10 years provided a system had previously taken three samples that were all less than 50 percent of the MCL. States should base their decision on prior analytical results, variation in analytical results, and system changes such as pumping rates or stream flows/characteristics.

EPA receives numerous comments on the 50 percent trigger for reduced monitoring with most commenters opposing the 50 percent trigger, calling it arbitrary and with no health significance. Other commenters suggested that the 50 percent trigger would result in a pseudo MCL. After reviewing the comments, EPA has decided to eliminate the 50 percent

trigger and change the requirement to three previous compliance samples (including one that was taken after January 1, 1990) that are "reliably and consistently" less than the MCL to give the States additional flexibility to decide which systems are eligible for reduced monitoring. Systems meeting this criterion are eligible for reduced monitoring (e.g., a waiver).

Most commenters supported the 10-year time frame as a reasonable monitoring frequency for reduced monitoring. Because EPA is adopting a 3/8/9 compliance cycle, EPA is changing the maximum reduced monitoring frequency from the proposed 10 years to 9 years to gain consistency in its regulations. EPA believes this change will have a minimal impact on systems. EPA is requiring one of the three previous samples to be taken since January 1, 1990. The other two samples could be taken at any time after June 24, 1977 when monitoring for inorganics started. Because the reduction in monitoring to every nine years begins in the 1993-2001 compliance cycle, EPA believes that one sample must be recent (i.e., taken after January 1, 1990) to preclude unduly long time frames occurring between samples. Systems receiving a waiver may monitor at any time during the nine-year compliance cycle, as designated by the State.

EPA believes that systems should use the same criteria outlined in the preamble of the proposal (as modified above) to reduce monitoring. Several commenters suggest that systems that meet the criteria automatically qualify for a waiver without State approval. EPA has rejected this approach because it believes that State approval is crucial in certain circumstances such as where the system is adjacent to a toxic waste site or other anthropogenic sources of contamination. EPA anticipates that in most cases, States will grant waivers expeditiously.

b. Asbestos—(1) Initial and Repeat Base Requirements. In the proposal, systems were not required to monitor for asbestos unless the State determined that the system was vulnerable to contamination within 18 months of promulgation. If vulnerable, systems were required to take one sample within five years of promulgation. EPA also proposed an alternative approach requiring all systems to monitor unless the system conducted a vulnerability assessment and the State determined the system was not vulnerable to asbestos contamination.

Most commenters supported the proposed approach, although several commenters suggested that the alternative approach was preferable.

EPA, in today's rule, is promulgating the alternative approach, which requires all systems to monitor for asbestos during the 1993 to 1995 compliance period. This approach, as discussed previously, results in an enforceable requirement, but the number of systems judged to be vulnerable should be the same as with the proposal, provided vulnerability assessments are conducted.

The base repeat frequency is once in the first three-year monitoring period of each nine-year cycle, which means that after the initial base monitoring requirement is completed, systems would not be required to monitor again until the 2002 to 2005 compliance period. EPA has not eliminated the repeat base requirement because of concern that there may be occurrence in a limited number of systems. Systems that are not vulnerable would continue to be eligible to receive waivers. EPA is requiring infrequent base monitoring requirements because of the low probability of occurrence, the limited analytic capabilities to measure asbestos, and the high analytical costs, and because of regulatory activities such as the corrosion control activities and asbestos/cement pipe ban, which EPA believes will reduce the future occurrence of this contaminant.

(2) Increased Monitoring. In the May 1989 proposal, ground and surface water systems exceeding 50 percent of the MCL in the initial sample were required to monitor every three years and annually, respectively. Several commenters suggested that the source of the water was not a valid criterion for determining repeat monitoring frequencies. EPA agrees and has modified the rule as described below to use the analytical result as the "trigger" for any repeat monitoring.

Most comments on the asbestos monitoring frequencies were in response to the 50 percent trigger for repeat monitoring. For the reasons discussed earlier, EPA has decided to eliminate the 50 percent trigger and use the MCL to determine repeat monitoring frequencies. EPA is prescribing the "baseline" approach described above for inorganics. Systems that exceed the MCL must initiate quarterly monitoring in the next calendar quarter. When the State determines that the system is "reliably and consistently" less than the MCL (a minimum of two samples for ground water and four for surface water), then the system can reduce its monitoring frequency to that set by the State but not less than the base requirement.

(3) Decreased Monitoring. Today's rule allows States to grant waivers based on a vulnerability assessment by

systems that considers contamination in the raw water supply and/or from the corrosion of asbestos/cement pipe (including pipe tapping and repair) in the distribution system. Systems not receiving a waiver must monitor at the base frequency. Because monitoring is not required in the second and third three-year periods, no waiver is needed in those monitoring periods.

Most commenters agreed with EPA's criteria for reducing monitoring. Consequently, the requirements are promulgated as proposed.

c. Nitrate (1) Initial and Repeat Base Requirements.—(A) Community and Non-Transient Water Systems. The proposed rule required ground and surface water systems to monitor at annual and quarterly intervals, respectively. Commenters were mixed in both supporting and opposing the increased frequency compared to the current requirements. Many commenters said that although nitrate occurrence was widespread, nitrate levels over time were steady. After reviewing the comments and reviewing occurrence data, EPA is convinced that nitrate occurrence is widespread and often has seasonal fluctuations resulting from factors such as when fertilizer is applied and rainfall events. Consequently, EPA believes nitrate monitoring frequencies should be increased, as proposed, to protect against the acute effect of methemoglobinemia. Therefore, today's rule retains the requirements as proposed. Under today's rule, monitoring for surface water systems will begin in the first quarter of 1993; CWS and NTWS groundwater systems and transient non-community systems (TWSs) must take one sample annually beginning in 1993.

The proposed rule required systems to monitor at the time of highest vulnerability, which most commenters suggested they were unable to determine. Since EPA agrees that determining the time of highest vulnerability is difficult, the Agency has decided to change the time when monitoring must be conducted. When a system changes its monitoring frequency from quarterly to annually, the annual sample must be taken in the calendar quarter(s) that previously yielded the highest previous analytical result. For example, if a system sampled in the first, second, third, and fourth quarters in the previous year and the analytical results were 1 mg/l, 3 mg/l, 4 mg/l, and 2 mg/l, respectively, the system is required to take its annual sample in the third quarter in the next year. Today's rule considers the third quarter the time of "highest vulnerability" for the system.

(B) Transient Non-Community Water Systems. The proposed rule required ground and surface water systems to monitor at three- and one-year intervals. In the proposal, EPA requested comment on the frequency of monitoring requirements for transient system. Most commenters supported the proposed frequencies; however, several commenters suggested that additional monitoring was appropriate since nitrate is regulated as an acute toxin.

EPA now believes that a monitoring frequency of every three years is not protective of health for nitrate, an acute toxin which is ubiquitous. Based on a review of the comments, EPA has decided to require all TWS systems (including groundwater systems) to monitor annually. Because analysis of nitrate is relatively inexpensive and a sample can be taken at the time the system takes a coliform sample, EPA believes the impact of this change on TWS will be minimal yet offer greater health protection. Consequently, EPA is promulgating annual sampling for groundwater systems.

(2) Increased Monitoring (CWS, NTWS, TWS). The proposed rule required groundwater CWSs and NTWSs to monitor at quarterly frequencies when the concentration is greater than 50 percent of the MCL for any one sample. The sampling frequency remains quarterly until four consecutive samples are less than 50 percent of the MCL. As discussed earlier, most commenters suggested deleting the 50 percent trigger for increased or decreased monitoring. Even though elsewhere in this rule the 50 percent trigger is eliminated, EPA has decided to retain the 50 percent trigger for increased nitrate monitoring in the case of nitrate and also to extend this requirement to TWSs. For this contaminant, EPA believes the 50 percent trigger constitutes an early warning signal for an acute contaminant. Although EPA considered other options as triggers for increased monitoring, such as the level of detection or the MCL, EPA believes these are not appropriate both because nitrate can be detected at levels far below the MCL and because the MCL represents the level where above this level acute effects may occur in some individual. Consequently, EPA believes that 5 mg/l remains the best trigger for increased nitrate monitoring. EPA believes that it is appropriate to extend the increased monitoring frequencies to include transient water systems because of the acute hazard posed by this contaminant.

EPA has decided to modify the requirement for decreased monitoring. In today's rule, a system that exceeds 50 percent of the MCL in any sample must remain on a quarterly monitoring schedule until a minimum of four consecutive samples are judged by the State to be "reliably and consistently" less than the MCL. EPA believes that this change allows States the flexibility to reduce the monitoring for those systems that, while they have detectable nitrates, are very unlikely to exceed the MCL until the next monitoring cycle.

(3) Decreased Monitoring (Surface CWS and NTWS). The proposed base monitoring requirement for surface water systems was quarterly. A reduction to annual sampling was permitted when four consecutive samples were less than 50 percent of the MCL. For the reasons explained above, EPA has decided to change the proposal somewhat to allow surface water systems to decrease to an annual frequency provided four consecutive samples are "reliably and consistently" less than the MCL.

d. Nitrite (1) Initial and Repeat Base Requirements. In the proposal, systems were required to monitor for nitrite at the same frequencies as for nitrate. After reviewing comments and reexamining limited occurrence information (i.e., State of Wisconsin, Public Water Supply Data, 1970), which indicates occurrence above 50 percent of the MCL was very infrequent, EPA has decided to require all systems to monitor once for nitrite in the first compliance period (1993 to 1995). If the analytical result is less than 50 percent of the MCL (0.5 mg/l), additional monitoring is at State discretion. However, future measurements under the nitrate requirement will mandate combined measurement of nitrate plus nitrite, both measured as nitrogen using a single analytical technique.

If the analytical result in the initial sample is equal to or greater than 50 percent of the MCL (i.e., ≥ 0.5 mg/l), systems must then monitor quarterly (with a minimum of four samples) until the State determines that the system is "reliably and consistently" less than the MCL. After that determination, systems must monitor at an annual frequency.

e. Volatile Organic Contaminants (VOCs)—(1) Initial and Repeat Base Requirements. In the VOC rule promulgated in July 1987, EPA required all systems to take four consecutive quarterly samples. Groundwater systems that conducted a vulnerability assessment and were judged not vulnerable, however, could stop monitoring after the first sample

provided no VOCs were detected in that initial sample. Repeat frequencies for all systems vary by system size, detection, and vulnerability status.

EPA has made several changes to the proposed VOC requirements. EPA is also today proposing to amend the July 1987 monitoring requirements for VOCs to streamlining the requirements and to make all VOC requirements consistent. In the May 1989 notice and in the VOC regulations promulgated in July 1987, distinctions in base requirements were made between ground and surface water systems, less than and more than 500 service connections, and vulnerable and non-vulnerable systems. EPA, in streamlining the requirements in today's rule, will require all systems to take four quarterly samples. Systems that do not detect VOCs in the original round of quarterly sampling are required to monitor annually beginning in the next calendar year after quarterly sampling is completed. The State may allow groundwater systems which conducted three years of sampling and did not detect VOCs to take a single sample every three years. For example, systems which complete quarterly monitoring in calendar year 1993 are required to begin annual monitoring in 1994. EPA is making this change for several reasons. First, the occurrence of VOCs in approximately 20 percent of systems indicates that shortening the time frame between when each sample is collected for vulnerable groundwater systems from every three to five years to an annual sample is appropriate. Second, the cost of analysis for VOCs has decreased since the original proposal. Most VOC analyses now cost approximately \$150 per sample versus the \$200 per sample EPA estimated in the 1987 VOC rule. Trihalomethanes (THMs) may also be measured in these samples, thereby creating efficiencies with current and future THM monitoring requirements. Consequently, the monitoring burden on most systems is less than previously thought. Third, most commenters preferred annual monitoring, stating that quarterly monitoring presented managerial and logistical problems. Where groundwater systems have a demonstrated history of non-detects for VOCs, EPA believes a reduction of monitoring to one sample during each compliance period, if allowed by the State, is protective of health. For the above reasons, EPA is promulgating the above monitoring requirement changes.

In the May 1989 notice, EPA requested comment on whether vulnerable systems may take only one sample if no VOCs are detected in the initial year of

monitoring. EPA's intent was to require quarterly sampling in vulnerable systems, but most commenters opposed a change to more frequent monitoring. Based on the comments received, EPA is requiring vulnerable systems to take an annual sample beginning in 1993 (instead of four quarterly samples) if no VOCs were detected in the initial (or subsequent) monitoring.

In today's rule, EPA is requiring systems to conduct an initial round of quarterly monitoring. In the 1987 VOC rule, however, EPA required systems to conduct unregulated contaminant monitoring for all VOCs contained in today's rule, and stated that those results could be grandfathered in for future regulatory requirements. Consequently, EPA will allow systems that have conducted monitoring under § 141.40 to use those results to satisfy the initial monitoring requirement for those VOCs included in today's rule even if a single sample, rather than four quarterly samples, was taken. Only new systems, existing systems with new sampling points, or systems that did not conduct monitoring under § 141.40 prior to December 31, 1992, are required to conduct initial base monitoring for the VOCs in today's rule during the 1993-1995 compliance period.

(2) *Increased Monitoring.* In the proposal, systems detecting VOCs (defined as any analytical result greater than 0.0005 mg/l) were required to monitor quarterly. In today's rule, EPA is requiring systems that detect VOCs to monitor quarterly until the State determines that the system is "reliably and consistently" below the MCL. However, groundwater systems must take a minimum of two samples and surface water systems must take a minimum of four samples before the State may reduce the monitoring to the base requirement (i.e., annual sampling).

Systems remain on an annual sampling frequency even if VOCs are detected in subsequent samples, unless an MCL is exceeded (or if the State otherwise specifies). In this case, the system returns to quarterly sampling in the next calendar quarter until the State determines that the new contamination has decreased below the MCL and is expected to remain reliably and consistently below the MCL. This determination shall again require a minimum of four quarterly samples for surface water systems and two quarterly samples for groundwater systems.

EPA is making this change because some systems may detect VOCs at a level slightly above the detection limit. EPA believes that where the State can determine that contamination is

"reliably and consistently" less than the MCL, those systems should be able to return to the base monitoring requirement (i.e., annually). Giving States the discretion to determine whether systems meet this criterion may allow States to give monitoring relief to some systems.

(3) *Decreased Monitoring.* States may grant waivers to systems that are not vulnerable and did not detect VOCs while conducting base monitoring. Vulnerability must be determined using the criteria specified above in the discussion of vulnerability assessments. EPA anticipates that most systems will not be able to qualify for a "use" waiver because of the ubiquity of VOCs. However, systems conducting an assessment that considers prior occurrence and vulnerability assessments (including those of surrounding systems), environmental persistence and transport, source protection, Wellhead Protection Assessments, and proximity to sources of contamination may apply to the State for a "susceptibility" waiver. If the waiver is granted, systems are required to take one sample and update the current vulnerability assessment during two consecutive compliance periods (i.e., six years). The vulnerability assessment update must be completed by the beginning of the second compliance period. EPA is increasing the time frame from five to six years to bring the five-year monitoring frequency in the proposal in line with the 3/6/9/-year frequencies specified in the standard monitoring framework.

EPA proposed that States have the discretion to set subsequent frequencies in systems that did not detect VOCs in the initial round of four quarterly samples and that are designated as not vulnerable based on assessment. Most commenters supported this provision, and it is promulgated as proposed. The repeat monitoring frequency for groundwater systems meeting this criteria shall be not less than one sample every six years as discussed above. For surface water systems meeting this criteria the repeat frequency is at State discretion.

f. Pesticides/PCBs—(1) Initial and Repeat Base Requirements. In the May 1989 proposal, systems were not required to monitor unless the State, on the basis of a vulnerability assessment, determined the system vulnerable. If vulnerable, systems were required to take four consecutive quarterly samples. EPA requested comment on an alternative approach that would require all systems to monitor for all contaminants. As discussed above, today's requirements specify that all

systems must take four quarterly samples every three years. However, all systems are eligible for waivers from the quarterly monitoring requirement, as discussed in the section on decreased monitoring below.

Most comments on the proposal revolved around two issues—the requirement that systems monitor quarterly and the requirement that all systems monitor at the time of highest vulnerability. Many commenters stated that quarterly monitoring was not necessary to detect changes in contamination. Many commenters recommended annual monitoring for pesticides. After reviewing the information and comments submitted, EPA believes that quarterly monitoring remains the best scheme to determine contamination. Occurrence information available to EPA indicates that seasonal fluctuations from runoff and applications of pesticides may occur; thus, quarterly monitoring is better than annual monitoring to determine pesticide contamination. In some cases it may be appropriate to monitor at greater frequencies than those specified by today's rule to better determine exposure. States and systems have the option to monitor at greater frequencies than the federal minimums.

Most commenters opposed the requirement to monitor at the time of highest vulnerability, stating that highest vulnerability cannot be predicted or determined. Several commenters stated that the requirement to monitor at the time of highest vulnerability was unenforceable. EPA agrees and eliminates this requirement from today's rule. However, States are advised to examine sampling practices of systems to assure that periods of likely contamination are not avoided. This is especially true for surface water systems monitoring for pesticides after rainfall and/or application of pesticides.

In the May 1989 notice, EPA proposed that systems conduct repeat monitoring every three or five years, depending on system size and ground/surface distinctions. In today's rule, the repeat monitoring frequency for all systems is four consecutive quarterly samples each compliance period. However, EPA has made several adjustments for systems that do not detect contamination in the initial compliance period. After the initial monitoring round is completed, systems that serve >3,300 persons may reduce the sampling frequency to two samples in one year during each compliance period. Systems serving <3,300 persons may reduce the sampling frequency to one sample. EPA has increased the frequency small

systems must monitor in this rule from every five years to every three years, because EPA believes that this change will offer greater health protection. EPA believes that every six years is too long an interval to determine changes in consumer exposure. In addition, because EPA has coupled this change with revised procedures for granting "use" waivers, the impact of this change will be minimal.

EPA has made the granting of "use" waivers for pesticides easier in this rule and will permit States to grant "area wide" or "Statewide" waivers based upon pesticide use information. EPA anticipates in adopting this scheme, along with the other changes outlined in today's rule, that many systems will be able to obtain a "use" waiver. For those systems not able to obtain a waiver (i.e., vulnerable systems), EPA believes it is appropriate to monitor at three-year intervals to determine contamination.

(2) Increased Monitoring. In the May 1989 notice, systems with less than 500 service connections that detect contamination were required to monitor annually. Systems with more than 500 service connections that detect pesticides are required to monitor quarterly. EPA defined detection as greater than 50 percent of the MCL. Most comments revolved around the 50 percent trigger. As discussed above, EPA is redefining detection for pesticides to mean using the method detection limit (see table 24). EPA believes it is appropriate to use the method detection limit as the trigger for reduced monitoring because detection implies that a pathway to contamination exists. Consequently, additional monitoring is required to determine the extent and variability of pesticide contamination. In today's rule, all systems that detect pesticides/PCBs must monitor quarterly until a reliable baseline has been established.

TABLE 24.—METHOD DETECTION LIMITS—PESTICIDES/PCBs

Contaminant	Detection Limit
Alechlor	0.0002 mg/l
Aldicarb	0.0005 mg/l
Aldicarb sulfonate	0.0005 mg/l
Aldicarb sulfonate	0.0005 mg/l
Atrazine	0.0001 mg/l
Carbaryl	0.0009 mg/l
Chlorpyrifos	0.002 mg/l
Dibromochloropropane (DBCP)	0.00002 mg/l
2,4-D	0.0001 mg/l
Ethion	0.0001 mg/l
Ethion sulfonate (EDE)	0.00001 mg/l
Heptachlor	0.00004 mg/l
Heptachlor epoxide	0.00002 mg/l
Lindane	0.0002 mg/l
Methoxychlor	0.0001 mg/l

TABLE 24.—METHOD DETECTION LIMITS—PESTICIDES/PCBs—Continued

Contaminant	Detection Limit
Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl)	0.0001 mg/l
Pentachlorophenol	0.00001 mg/l
Toxaphene	0.001 mg/l
2,4,5-TP (Silvex)	0.0002 mg/l

As described previously, upon detection, all systems must immediately begin quarterly monitoring. The State may reduce the system to annual monitoring after determining it is "reliably and consistently" below the MCL. A reduction to annual monitoring may occur after a minimum of two samples for groundwater and four samples for surface water systems. After three years of annual monitoring which remains "reliably and consistently" below the MCL, systems can return to the base monitoring requirement (i.e., four quarterly samples every three years).

(3) Decreased Monitoring. Systems that obtain a waiver from the monitoring requirements are not required to monitor. All systems are eligible for waivers in the first three-year compliance period of 1993 to 1995. As discussed above, EPA has simplified the vulnerability assessment procedures by allowing the system to assess whether the contaminant has been used, transported, mixed, or stored in the watershed or zone of influence. Where previous pesticide/PCB use in the area can be ruled out, systems may apply to the State for a use waiver. EPA's intent in promulgating this change is to make it easier for systems to obtain waivers in those situations where the chemical has not been used. States may be able to determine that the entire State or specific geographic areas of the State have not used the contaminant and consequently granted "area wide" waivers. Systems that cannot determine use may still qualify for a waiver by evaluating susceptibility according to the criteria discussed in the VOC section above. Waivers must be renewed every three years.

EPA requested comments on whether systems that did not detect canceled pesticides in the initial monitoring round should be presumed to be non-vulnerable and therefore not required to monitor. After reviewing the comments and information on illegal pesticide use, EPA continues to believe that no occurrence improves the likelihood that the State will grant a waiver from continued monitoring of a canceled pesticide. Due to possible persistence in the environment, however, EPA does not

agree with commenters who believe that waivers should be granted automatically.

5. Other Issues

a. Compliance Determinations.

Several commenters suggested that, for a compliance determination, a single sample or four quarterly samples are not representative of water delivered to consumers. Several commenters suggested that EPA adopt an averaging period of longer than one year for compounds posing chronic health hazards. EPA continues to believe that any excursion above an MCL presents a risk to health and should be addressed immediately. However, in a practical sense, most systems would not immediately install treatment until establishing a baseline based on additional monitoring to determine the extent of the problem. Several years will elapse after a violation before treatment is installed. Consequently, the concern of the commenter that a single sample may result in treatment is unfounded. EPA wishes to point out that water systems can always submit a sampling plan (subject to State approval) that includes more monitoring than the minimum established by EPA, if that will result in a better representative sample.

Several commenters opposed the proposed requirement that a system is immediately out of compliance and must give public notice if the initial or the total of subsequent samples is more than four times the MCL. The commenters were concerned that non-compliance may be based on a single sample. EPA points out that any quarterly sample that exceeds the MCL by four times would result in an annual average that exceeds the MCL. EPA continues to believe that this approach gives early warning to consumers that a health problem may exist. EPA has clarified how the annual average is calculated by specifying that any analyses below the detection limit shall be calculated as zero.

Several commenters opposed the requirement that if a single sampling point is out of compliance, then the entire system is out of compliance. As previously stated, EPA has adopted this policy because EPA determines system compliance, not sampling point compliance.

EPA wishes to point out and clarify that once a system is waived from specific measurement of nitrite, as discussed above, compliance will be determined through a measurement of combined nitrate and nitrite (measured

as N). The MCL for this combined measurement remains at 10 mg/l as N.

b. Confirmation Samples. EPA proposed that if an analytical result greater than 10 mg/l for nitrate and 1 mg/l for nitrate indicates that the system may exceed the MCL, then that system must take a confirmation sample within 24 hours of notification of the analytical result. Results from both samples must be reported to the State within two weeks of the date the initial sample was taken. Most commenters opposed the requirement to take a confirmation sample within 24 hours of notification, stating that it was impractical to require a system to monitor that quickly. EPA agrees with the commenters and has modified today's rule to allow systems in which the first sample exceeds the MCL to notify the public within 24 hours of receipt of the analytical results through posting, mail notification, or radio/TV that the system may be in violation. If the system decides to take this option, then it must take a confirmation sample within two weeks of the original notification.

c. Compositing. In the May 1989 proposal EPA allowed systems, at the discretion of the State, to composite up to five samples. Compositing must be done in the laboratory. Most commenters supported compositing as a methodology to cut costs. In this final rule, EPA is limiting compositing among different systems to only those systems serving fewer than 3,300 people. Systems serving greater than 3,300 persons will be allowed to composite but only within their own system. EPA also requested comments on whether State discretion on compositing is necessary or whether systems can composite automatically without State approval. Several States opposed this change; consequently, the final rule is unchanged from the proposal. EPA believes that compositing is to be used only when cost savings are important and systems alone should not make that determination.

d. Asbestos. Some commenters were confused by the wording used to specify sampling points in a distribution system for measuring asbestos when a system or part of a system is judged vulnerable. EPA wishes to clarify that collecting a sample at a consumer tap is not necessary. It is sufficient to collect at a convenient place in those parts of the distribution system that have been deemed vulnerable to asbestos contamination.

6. Unregulated Contaminant Monitoring

EPA proposed requirements to monitor for other "unregulated"

contaminants. "Unregulated" contaminants are those contaminants for which EPA establishes a monitoring requirement but which do not have an associated MCLG, MCL, or treatment technique (see table 25). EPA may regulate these contaminants in the future.

TABLE 25.—UNREGULATED INORGANIC AND ORGANIC CONTAMINANTS

	EPA analytical method
<i>Organic contaminants</i>	
Aldrin.....	505, 508, 525
Benzo(a)pyrene.....	525, 550, 550.1
Butachlor.....	507, 525
Carbaryl.....	531.1
Delapron.....	515.1
Di-2(ethylhexyl)adipate.....	508, 525
Di-2(ethylhexyl)phthalates.....	508, 525
Dieldrin.....	515.1
Dieldrin.....	505, 508, 525
Dinoseb.....	515.1
Diquat.....	549
Endosulf.....	548
Glyphosate.....	547
Hexachlorobenzene.....	505, 508, 525
Hexachlorocyclopentadiene.....	505, 525
3-Hydroxycarbofuran.....	531.1
Methomyl.....	531.1
Metolachlor.....	507, 525
Metribuzin.....	507, 508, 525
Oxamyl (vydate).....	531.1
Picloram.....	515.1
Propanil.....	507, 525
Simazine.....	505, 507, 525
2,3,7,8-TCDD (Dioxin).....	513
<i>Inorganic contaminants</i>	
Antimony.....	Graphite Furnace Atomic Absorption; Inductively Coupled Plasma.
Beryllium.....	Graphite Furnace Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma; Spectrophotometric.
Nickel.....	Atomic Absorption; Inductively Coupled Plasma; Graphite Furnace Atomic Absorption.
Sulfate.....	Colorimetric.
Thallium.....	Graphite Furnace Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma; Spectrophotometric.
Cyanide.....	Spectrophotometric.

EPA proposed monitoring requirements for approximately 110 "unregulated" organic chemicals and six inorganic chemicals. These "unregulated" contaminants were divided into two priority groups. The monitoring requirements for contaminants in the priority #1 group only apply to those systems vulnerable to the contaminant. EPA proposed that States may require additional monitoring for those contaminants in the priority #2 list based upon local concerns and priorities.

For priority #1 contaminants, EPA proposed that States must conduct a vulnerability assessment within 18 months of promulgation for each contaminant. The vulnerability assessment would determine the specific contaminants for which community and non-transient systems must monitor. EPA also proposed an alternative scheme that would require all systems to monitor unless a vulnerability assessment determined that the system was not vulnerable.

Most commenters supported the concept of vulnerability assessments to determine which systems monitor. EPA in today's rule, is making several changes to the proposal based on the comments. First, EPA is adopting the alternative monitoring scheme that requires all systems to monitor for the organics unless a vulnerability assessment determines the system is not vulnerable. Second, all systems must complete the monitoring by the end of the first monitoring period (i.e., December 31, 1995) rather than four years after publication of the rule in the Federal Register, as discussed previously. Third, EPA is dropping the priority #2 list of contaminants for which States may use their discretion in monitoring. Systems, however, are encouraged to monitor for all contaminants contained in a specific analytical methodology. Fourth, EPA is adding three contaminants, which were proposed in the list of 24 contaminants on July 25, 1990 (55 FR 30370). Fifth, EPA is eliminating 2,4,5-TP (Silvex) from the list, as it is a regulated contaminant in today's rule.

Most commenters expressed concern about the resource requirements for conducting vulnerability assessments for the unregulated contaminants. EPA believes the incremental resources required to conduct vulnerability assessments for unregulated contaminants are minimal because all systems will be required to monitor and/or conduct a vulnerability assessment for the regulated contaminants.

E. Variances and Exemptions

1. Variances

Under section 1415(a)(1)(A) of the SDWA, EPA or a State that has primacy may grant variances from MCLs to those public water systems that cannot comply with the MCLs because of characteristics of their water sources. If the time a variance is granted, the State must prescribe a compliance schedule and may require the system to implement additional control measures

The SDWA requires that variances may only be granted to those systems that have installed BAT (as identified by EPA). However, in limited situations a system may receive a variance if it demonstrates that the BAT would only achieve a *de minimus* reduction in contamination (see § 142.62(d)). Before EPA or a State issues a variance, it must find that the variance will not result in an unreasonable risk to health.

Under section 1413(a)(4) of the Act, States with primacy that choose to issue variances must do so under conditions and in a manner that is no less stringent than EPA allows under section 1415. Before a State may issue a variance, it must find that the system is unable to (1) join another water system, or (2) develop another source of water and thus comply fully with all applicable drinking water regulations.

The Act permits EPA to vary the BAT established under section 1415 from that established under section 1412 based on a number of findings such as system size, physical conditions related to engineering feasibility, and the cost of compliance. Paragraph 142.62 of this rule lists the BAT that EPA has specified under section 1415 of the Act for the purposes of issuing variances. This list mirrors the proposed list except that electrodialysis is considered BAT for barium, nitrate, and selenium as discussed in "Selection of Best Available Technology" above.

EPA received several comments on its proposed list of section 1415 BAT. The commenters agreed with EPA that coagulation/filtration and lime softening should be excluded as BAT for those systems serving <500 service connections. In the proposal, EPA requested comment on whether reverse osmosis, activated alumina, and ion exchange should be considered BAT for small systems because of the relatively high costs of these technologies. EPA also stated that it was continuing to evaluate what costs are feasible for public water systems and that it was currently examining alternative affordability criteria. EPA also requested comments on whether PTA should be BAT for DBCP and EDB because of high air-to-water ratios resulting in increased costs.

In the proposal, EPA based its cost estimates on designs reflecting best engineering practice. Some of the assumptions underlying these cost estimates may be unrealistic, considering the nature of small water systems and their ability to procure, finance, or operate facilities. In other cases, the assumptions did not reflect EPA's best understanding of design and average flows in water systems, the cost

of waste treatment, or the costs of engineering more likely to be used by small water systems. A reexamination of these assumptions has led EPA to conclude that the costs of treatment to a water system and its customers may lie within a very wide range depending on site-specific conditions and requirements.

EPA has produced a draft report entitled "Small System Technology Cost Revisions" (U.S. EPA, Office of Drinking Water, May 1990), which describes the cost of treatment trains that are more likely to be used in small water systems. The costs in that report are based on engineering assumptions different from those used to cost very small system technologies at the time of the proposal. Differences between engineering assumptions and those used in the proposal include, for example, purchase of prebuilt sheds rather than full construction of a shed.

Cost estimates in the "Small System Technology Cost Revisions" draft report of technologies with contaminant removal capability equivalent to those discussed in the proposal are significantly lower. For example, the cost of removing chromium using two-bed ion exchange treatment in a water system serving 25-100 people was listed in the proposal at \$3.40/1,000 gallons. As a result of updating flow and waste disposal assumptions, the cost is now estimated at \$10.16/1,000 gallons. This is equivalent to about \$1,000 per year per household served by the water system. In the draft report, the cost of using ion exchange treatment (as described in the May 1990 draft report) is only \$0.91/1,000 gallons, or about \$90 per year per household in this size water system, assuming no need for off-site waste disposal. If off-site waste disposal is necessary, costs per household might grow to about \$200-\$300/yr, still significantly less than the \$1,000/yr associated with more expensive engineering assumptions.

EPA recognizes that its May report is not only a draft, but also only a preliminary investigation into the actual costs likely to be incurred by very small water systems. The report, however, confirms substantial anecdotal evidence that EPA's previous small systems costs may be overestimated in some circumstances. As a result of this reevaluation of costing assumptions, EPA concludes that low-cost treatment trains using the section 1415 technologies could be affordable. Therefore, EPA finds that all technologies as listed in tables 26 and 27 are section 1415 BAT.

2. Point-of-Use Devices, Bottled Water and Point-of-Entry Devices

Under section 1415(a) of the SDWA, when the State grants a variance or exemption, it must prescribe an implementation schedule and any additional control measures that the system must take. States may require the use of point-of-use (POU) devices, bottled water, and other mitigating devices as "additional" control measures if an "unreasonable risk to health exists." One commenter stated that EPA should also include point-of-entry (POE) devices as an additional option. EPA agrees and has amended §§ 142.57 and 142.62 in today's rule to allow POE devices as an interim control measure while a variance or exemption is in effect. Public water systems may also use POE devices for full compliance with the MCLs if they meet certain criteria and procedures specified in 40 CFR § 141.100.

3. Exemptions

Under section 1416(a), a State or EPA may grant an exemption extending deadlines for compliance with a treatment technique or MCL if it finds that (1) due to compelling factors (which may include economic factors), the PWS is unable to comply with the requirement; (2) the exemption will not result in an unreasonable risk to human health; and (3) the system was in operation on the effective date of the NPDWR, or, for a system not in operation on that date, no reasonable alternative source of drinking water is available to the new system.

In determining whether to grant an exemption, EPA expects the State to determine whether the facility could be consolidated with another system or whether an alternative source could be developed. Another compelling factor is the affordability of the required treatments. It is possible that very small systems may not be able to consolidate or find a low-cost treatment. EPA anticipates that States may wish to consider granting an exemption when the requisite treatment is not affordable.

EPA believes that, as a rule of thumb, a total annual household water bill becomes unaffordable when it is greater than 2 percent of the median household income, or about \$650/household/year, if calculated based on median national income. EPA realizes that affordability cannot be characterized by a single threshold, and believes that in cases where local median income is very low, a total annual household water bill as small as \$450 may be unaffordable. EPA

believes that any total annual bills below that amount are affordable.

EPA considered a wide variety of information when formulating this unaffordability rule of thumb. Today, the average annual household water bill is about \$250. To supplement centrally treated and piped water with bottled water costs about \$400 more per year, a cost many people throughout the nation are willing to pay on an increasingly frequent basis. This mirrors the market costs of various POU and POE devices intended to provide safe drinking water and which now constitute an active household products market. In addition, EPA's rule of thumb is similar to that used by the Department of Agriculture's Farmers' Home Administration (FmHA) guidance on the use of grants in place of loans, based on hardship. Finally, the 2 percent of median income, \$650/yr, value is about equal to the highest existing annual water bills, although abnormally high rates (greater than \$1,000/yr) have been documented in a handful of communities. EPA believes its rule of thumb reflects both what many people consider affordable for high quality water and established federal policy with regard to economic hardship.

When considering the appropriateness of an exemption based on affordability, the States should ensure that a full faith effort has been made to consider low-cost solutions similar to those examined in the May 1990 draft EPA report.

Several commenters also indicated that affordability considerations should include all treatments that might need to be applied by a water system, not merely those associated with this rule. EPA agrees with these comments, and expects States will review all the treatment requirements of water systems to add as many treatment techniques as are affordable. Where the total treatment need is not affordable, those treatments should be required that result in the greatest risk reduction, while remaining affordable under the criteria given above.

Under section 1416(b)(2)(B) of the Act, an exemption may be extended or renewed (in the cases of systems that serve less than 500 service connections and that need financial assistance for the necessary improvements) for one or more two-year periods. EPA believes that information on low-cost technologies will receive a considerable amount of attention over the next several years and States giving exemptions based on affordability should be prepared to require small water systems to regularly re-examine the available technologies to ensure that

any new low-cost opportunities are applied, where appropriate.

TABLE 26.—SECTION 1415 BAT FOR INORGANIC COMPOUNDS

Chemical	BATs
Asbestos	2, 3, 8
Barium	5, 6, 7, 9
Cadmium	2, 5, 6, 7
Chromium	2, 5, 6, 7
Mercury	2, 1, 4, 6, 7
Nitrate	5, 7, 9
Nitrite	5, 7
Selenium	1, 2, 5, 6, 7, 9

¹ BAT only if influent HG concentrations are <10 µg/l.

² BAT for Chromium III only.

³ BAT for Selenium IV only.

Key to BATs in Table 26

- 1= Activated Alumina.
- 2= Coagulation/Filtration (not BAT for systems with <500 service connections).
- 3= Direct and Diatomite Filtration.
- 4= Granular Activated Carbon.
- 5= Ion Exchange.
- 6= Lime Softening (not BAT for systems with <500 service connections).
- 7= Reverse Osmosis.
- 8= Corrosion Control.
- 9= Electrodialysis.

TABLE 27.—SECTION 1415 BAT FOR ORGANIC COMPOUNDS

Chemical name	Packed tower aeration	Granular activated carbon
Benzene	x	x
Carbon tetrachloride	x	x
1,2-Dichloroethane	x	x
Trichloroethylene	x	x
para-Dichlorobenzene	x	x
1,2-Dichloroethylene	x	x
1,1,1-Trichloroethane	x	x
Vinyl chloride	x	x
cis-1,2-Dichloroethylene	x	x
1,2-Dichloropropane	x	x
Ethylbenzene	x	x
Monochlorobenzene	x	x
ortho-Dichlorobenzene	x	x
Styrene	x	x
Tetrachloroethylene	x	x
Toluene	x	x
trans-1,2-Dichloroethylene	x	x
Xylenes (total)	x	x
Alachlor		x
Aldicarb		x
Aldicarb sulfonate		x
Aldicarb sulfone		x
Atrazine		x
Carbofuran		x
Chlordane		x
Dibromochloropropane	x	x
2,4-D		x
Ethylene dibromide	x	x
Heptachlor		x
Heptachlor epoxide		x
Lindane		x
Methoxychlor		x
PCBs		x

TABLE 27.—SECTION 1415 BAT FOR ORGANIC COMPOUNDS—Continued

Chemical name	Packed tower aeration	Granular activated carbon
Pentachlorophenol		x
Toxaphene		x
2,4,5-TP		x

F. Laboratory Certification

Commenters inquired whether EPA would be utilizing method certification for laboratory approval or certifying laboratories for each individual contaminant. EPA recognized this need and adopted this former system in the VOC final rule (52 FR (130) 25720, July 6, 1987). Under the performance requirements for the July 1987 VOC regulation, laboratories had to pass certification requirements for six out of seven VOCs (excluding vinyl chloride). EPA would like to extend this philosophy to all its regulated analytes to reduce the burden on the regulated community, since it recognizes that even the best laboratories cannot achieve 100 percent success every time they participate in performance studies. At this time, however, only the VOCs have a large enough group of regulated analytes to make this method useful.

Today's rule will require laboratories to pass 80 percent of the regulated analytes that are present in a performance sample, including vinyl chloride, at the current acceptance limits set for VOCs. The other inorganic and organic analytes will continue to be approved at the limits set for them on an individual basis. When this rule is effective, 18 VOCs will be analyzed; a performance sample may include all 18 or only a portion (e.g., 10 VOCs). A laboratory will have to pass 15 out of 18 or 8 out of 9 to stay certified.

G. Public Notice Requirements

1. General Comments

Three commenters stated that the notification language is too vague and alarming. Two commenters thought the notices may unduly alarm the public about minor violations or, conversely, the public may become immune to the notices when there are serious health concerns. One of these commenters stated that the public notification language should be guidance, and States should be allowed to determine what language is appropriate. Another commenter thought the notifications should be left to State health officials. One commenter recommended that EPA specifically state that water systems can

append the notification to include information on the nature, severity and context of potential health effects, as well as other useful information. One commenter stated that more detail and explanation is needed to define "little or no risk," which is the generic conclusion of each notification. This commenter suggested that more of the risk assessment assumptions be included (e.g., lifetime consumption of 2 liters per day with a x-fold safety factor). One commenter similarly felt some indication that a margin of safety is used to establish MCLs is needed.

EPA Response. EPA believes the public notification language is sufficiently detailed for the public and should not be unnecessarily alarming. Some language has been modified based on the chemical-specific comments that were received.

EPA believes that mandatory language is the most appropriate (if not the only) way to inform the affected public of the health implications of violating a particular EPA standard. It is appropriate for EPA to specify the language because the Agency is familiar with the specific health implications of violating each standard which were documented in the course of developing the NPDWRs. EPA is aware that the health implications of these violations do vary in their magnitude. Public water systems are free to make that point in their public notices as long as the mandatory language is included as well. For instance, the system may want to note that its violation is only slightly above the standard. In fact, the public water system or State may supplement the notice as long as the notice informs the public of the health risks which EPA has associated with violation of the standards and the mandatory health effects language remains intact.

EPA believes the public notifications should be in non-technical terms. Providing the specific risk assessment assumptions or discussing the margin of safety would be too detailed and raise confusion.

2. Contaminant-Specific Comments

a. Asbestos. Four commenters stated that the language for asbestos should not state that the standard is based on reducing cancer risks, since asbestos is not a carcinogen. Two commenters asked that the statement be revised to separate the insulating and fire retardant uses from A/C pipe uses. One commenter suggested the following modification for asbestos: "Ingestion of asbestos is associated with polyps (benign tumors) in rats."

EPA Response. EPA agrees with most of the comments received on asbestos

and has modified the public notification language accordingly. The standard for asbestos is based on reducing possible human cancer risks from drinking water exposure.

b. Other Contaminants. One commenter stated that the language for selenium should be revised to explain the nutritional essentiality of selenium. One commenter stated that the nitrate language should state that alternate water sources should be provided to children under one year of age. One commenter recommended modified wording for styrene. One commenter agreed with the notification language for alachlor and monochlorobenzene. One commenter recommended the following replacement wording for pesticides: "Under certain soil and climatic conditions (e.g., sandy soil and high rainfall), substance 'X' may leach into ground water after normal agricultural applications or may enter drinking water supplies as a result of surface runoff." One commenter believes the statement concerning liver and kidney effects from atrazine is an error. This same commenter provided suggested changes for 20 chemicals. One commenter believes the cadmium language, "Smoking of tobacco is a common source of general exposure," is inappropriate; this commenter believes that the notifications should only include information on occurrence or exposure from drinking water. This same commenter believes the language for the polymers acrylamide and epichlorohydrin is too alarming considering the minimal risk. Another commenter suggested changes for the acrylamide notice.

EPA Response. EPA believes that the current language stating the nutritional essentiality of selenium is sufficient. Consumers may obtain additional information concerning essentiality from the appropriate State regulatory agency. For nitrate/nitrite, EPA agrees that the age should be specified. However, EPA disagrees with an age of one year as all data suggest that infants under the age of six months are the sensitive population. EPA has modified the notice accordingly.

EPA agrees with most of the comments received on styrene and with the proposed generic changes for pesticides and has modified the public notification accordingly.

EPA also agrees that the atrazine language should better reflect the study used to derive the MCLG, and the public notification language has been modified accordingly.

EPA believes the potential risks from misuse of acrylamide and epichlorohydrin are properly qualified in

the proposed public notification language, and therefore should not result in under public alarm.

EPA has considered other chemical-specific changes and has modified the language in some cases (see the Comment/Response Document for detailed response to comments).

H. Secondary MCLs

EPA proposed secondary maximum contaminant levels (SMCLs) based on taste and odor detection levels for seven organic chemicals (o-dichlorobenzene, p-dichlorobenzene, ethylbenzene, pentachlorophenol, styrene, xylene, and toluene) and for silver and aluminum. These organic chemicals had reported taste or odor detection levels lower than the proposed (or final) MCLs. EPA believed it appropriate to set SMCLs for these compounds to protect against aesthetic effects (such as odor) which could be present at levels below the proposed MCLs.

1. Organics

After reviewing the public comments, EPA has decided to defer promulgating SMCLs for the seven organic chemicals for the following reasons:

A number of commenters opposed SMCLs for the seven organics due to an inadequate experimental basis for setting SMCLs for ethylbenzene, styrene, toluene, and xylene. While the literature citation used for these chemicals (Amoores and Hautala, 1963) was based on theoretical extrapolation (from air odor thresholds) and while it appeared to provide valid levels, it was not confirmed in any published literature.

The experimental identification of any chemical concentration in drinking water with a perceived aesthetic effect presents a difficult and currently unresolved task. Minimum detection levels, although different in different waters, might be identified but the point of consumer complaint for each chemical, in different waters, would require more study and research.

EPA is none the less convinced that taste and odor problems represent a significant continuing and unresolved problem for drinking water suppliers and their consumers. Accordingly, EPA may initiate a "National Task Force of Experts" to review and assess the data, information, and opinions available with respect to taste and odor problems in public water supplies. In addition problem definition, possible SMCL and analytical options available, and means for implementing solutions. If initiated, the task force would develop one or more SMCL approaches with developed

analytical technology for possible adoption in a proposed future secondary regulation amendment. The task force may also provide supplementary guidance relating to detectable and aesthetically displeasing levels for specific organic chemicals.

EPA wishes to alert the States, utilities, and consumers that it is retaining the existing odor SMCL of 3 Total Odor Number (TON) (see 40 CFR 143.3). Utilities are urged to find imaginative ways to meet the objective of having more pleasing odor characteristics for their finished water using the current 3 TON standard.

Where officials and consumers find contaminated drinking waters, they may expect to detect (possibly slight) tastes or odors at the concentrations indicated below:

o-Dichlorobenzene 0.01 mg/l.
p-Dichlorobenzene 0.005 mg/l.
Ethylbenzene 0.03 mg/l.
Pentachlorophenol 0.03 mg/l.
Styrene 0.01 mg/l.
Toluene 0.04 mg/l.
Xylene 0.02 mg/l.

2. Aluminum

A total of 17 individuals or organizations provided comments in response to the proposed SMCL of 0.05 mg/l for aluminum. All of these commenters agreed that the proposed SMCL is too low and should either be increased or eliminated.

Pertinent points from the comments are summarized as follows:

- The American Water Works Association (AWWA) no longer backs the quality goal of 0.05 mg/l which it initially adopted on January 28, 1968 but does support a "recommended operating level of 0.2 mg/l."

- The proposed SMCL of 0.05 mg/l would be very difficult for many utilities to meet: a 1987 AWWA/Research Foundation Survey of 90+ utilities indicated an average aluminum concentration of 0.09 mg/l in finished water. Individual utilities also expressed concern with difficulty in meeting the 0.05 mg/l SMCL.

- There is insufficient experimental data to define the level at which an aesthetic effect might occur in various waters and treatments.

EPA believes that in some waters post-precipitation of aluminum may take place after treatment. This could cause increased turbidity and aluminum water quality slugs under certain treatment and distribution changes. EPA also agrees with the World Health Organization (WHO, 1984) that

"discoloration of drinking water in distribution systems may occur when the aluminum level exceeds 0.1 mg/l in the finished water." WHO further adopts a guidance level of 0.2 mg/l in recognition of difficulty in meeting the lower level in some situations. While EPA encourages utilities to meet a level of 0.05 mg/l where possible, it still believes that varying water quality and treatment situations necessitate a flexible approach to establish the SMCL. What may be appropriate in one case may not be appropriate in another. Hence, a range for the standard is appropriate. The definition of "secondary drinking water regulation" in the SDWA provides that variations may be allowed according to "other circumstances." The State primacy agency may make a decision on the appropriate level for each utility on a case-by-case basis. Consequently, for the reasons given above, the final SMCL for aluminum will be a range of 0.05 mg/l to 0.2 mg/l, with the precise level then being determined by the State for each system.

3. Silver

On May 22, 1989, EPA proposed to delete the current MCL for silver (Ag), because the only potential adverse effect from exposure to silver in drinking water is argyria (a discoloration of the skin). EPA considers argyria a cosmetic effect since it does not impair body function. Also, silver is seldom found at significant levels in water supplies and drinking water has never been identified as the cause of argyria in the United States. While the health effects of silver may only be cosmetic, many home water treatment devices use silver as an antibacterial agent. These devices may present a potential contamination threat when used in a system. Therefore, EPA proposed (54 FR 22082) an SMCL for silver at 0.09 mg/l based on the skin cosmetic effect called argyria. EPA also asked the public to comment on the selection of an uncertainty factor (UF) in the alternate calculation of SMCL, assuming an oral absorption factor of 4 percent.

Public Comments. A total of six individuals or organizations provided comments in response to the proposed rule regarding silver. All commenters agreed that the MCL for silver (0.05 mg/l) should be deleted. Several commenters agreed with EPA's proposal of an SMCL for silver. Other commenters disagreed with this proposal, citing the following reasons for support:

- Silver does not affect the taste, odor, color, or appearance of the drinking water.

- There is no evidence that the low level of silver that might be found in drinking water causes argyria in humans.

In response to a specific question posed in the **Federal Register** Notice on the selection of a UF for the alternate calculations of the SMCL, different opinions were expressed. Several commenters suggested using an uncertainty factor of 2 in support of 25 mg/l, while one proposed to keep the SMCL at the current MCL of 0.05 mg/l.

EPA Response. EPA has decided a SMCL of 0.1 mg/l is needed to protect the general public from the cosmetic effect of argyria (from lifetime exposure to silver). While the health effects of silver may only be cosmetic, many home water treatment devices use silver as an antibacterial agent, thus presenting a potential contamination threat when such devices are used in a system. Therefore, EPA has decided to keep the SMCL at 0.1 mg/l to protect the welfare of the general public from the cosmetic effect of argyria.

EPA is proposing to use the same data base as before to calculate the SMCL for silver. Assuming 1 g of silver by i.v. will cause argyria in the most sensitive individuals (Gaul and Staud, *Am. Med. Assoc.* 104:1387-1390, 1935; Hill and Pillsbury, 1939) and assuming an oral absorption rate of 4 percent (Furchner et al., *Health Physics* 15:505-514, 1968), a lifetime exposure of 70 years, and a UF of 3, an SMCL of 0.1 mg/l is derived. For more detail, see the following derivation of SMCL.

a. Derivation of SMCL for Silver. The cosmetic DWEL is calculated assuming 1 g of silver administered i.v. will produce a mild argyria in the most sensitive individuals (Gaul and Staud, 1935; Hill and Pillsbury, 1939). Assuming 4 percent absorption of silver (Furchner et al., 1968) following oral exposure, the i.v. dose corresponds to an oral dose of 25 g (1 g/0.04 = 25 g). This dose is then averaged over a lifetime assumed to be 70 years:

$$25 \text{ g} \times \frac{\text{lifetime}}{25,550 \text{ days}} = 978 \text{ } \mu\text{g/day}$$

Based on an adult body weight of 70 kg, this corresponds to 14 $\mu\text{g/kg/day}$ (978 $\mu\text{g/day}$ / 70 kg = 14 $\mu\text{g/kg/day}$).

Step 1—Cosmetic RfD Derivation

$$\text{Cosmetic RFD} = \frac{14 \mu\text{g Ag/kg/day}}{3} = 4.7 \mu\text{g Ag/kg/day}$$

where:

14 $\mu\text{g Ag/kg/day}$ = Lowest Observed

Cosmetic Effect Level based on argyria.

3 = uncertainty factor.

An uncertainty factor of 3 was applied for the following reasons. First, a 10-fold uncertainty factor is usually applied to human data to account for intraspecies variability. However, since this derivation has already included sensitive individuals, a 10-fold uncertainty factor is not warranted. Second, an uncertainty factor less than 10 (i.e., 3) is sufficiently protective since the estimated dose causing argyria within one to three years is being apportioned over a lifetime. Finally, the effect is based on argyria, which is considered a cosmetic effect, and not an adverse health effect.

Step 2—Cosmetic DWEL Derivation

$$\text{Cosmetic DWEL} = \frac{4.7 \mu\text{g Ag/kg/day} \times 70 \text{ kg}}{2 \text{ l/day}}$$

= 164 $\mu\text{g/l}$ (rounded to 200 $\mu\text{g/l}$)

where:

4.7 $\mu\text{g Ag/kg/day}$ = Cosmetic RFD.

70 kg = assumed body weight of an adult.

2 l/day = assumed water consumption by an adult.

The Cosmetic DWEL is derived on the assumption that 100 percent of the silver intake comes from drinking water. As estimated by the World Health Organization (WHO, 1980), the upper bound of intake level for silver from food is 20 to 80 μg per day; from air it is essentially negligible. Therefore, the SMCL for the cosmetic effect of silver can be calculated by subtracting the amount obtained in food.

Step 3—SMCL

$$\text{SMCL} = \frac{(0.0047 \text{ mg/kg/day}) (70 \text{ kg}) - 0.06 \text{ mg/day}}{2 \text{ l/day}}$$

= 0.12 mg/l (rounded to 0.1 mg/l or 100 $\mu\text{g/l}$)

I. State Implementation

The Safe Drinking Water Act provides that States may assume primary implementation and enforcement responsibilities. Fifty-four out of 57 jurisdictions have applied for and received primary enforcement responsibility (primacy) under the Act. To implement the federal regulations for drinking water contaminants, States must adopt their own regulations which are at least as stringent as the federal regulations. This section of today's rule describes the regulations and other procedures and policies the States must adopt to implement today's rule. EPA previously promulgated program implementation requirements in 40 CFR part 142 on December 20, 1989 (54 FR 52128).

To implement today's rule, States will be required to adopt the following regulatory requirements when they are promulgated: § 141.23, Inorganic Chemical Sampling and Analytical Requirements; § 141.24, Organic Chemical Other Than Total Trihalomethanes Sampling and Analytical Requirements; § 141.32, General Public Notice Requirements (i.e., mandatory health effects language to be included in public notification or violations); § 141.40, Special Monitoring for Inorganic and Organic Chemicals; § 141.61 (a) and (c), Maximum Contaminant Levels for Inorganic and Organic Chemicals; and § 141.111, Treatment Techniques for Acrylamide and Epichlorohydrin.

In addition to adopting drinking water regulations no less stringent than the federal regulations listed above, EPA is requiring that States adopt certain requirements related to this regulation in order to have their program revision application approved by EPA. In various respects, the proposed NPDWRs provide flexibility to the State with regard to implementation of the monitoring requirements under this rule. Because State determinations regarding vulnerability and monitoring frequency will have a substantial impact with implementation of this regulation, the

proposed rule requires States to submit as part of their State program submissions their policies and procedures in these areas. This requirement will serve to inform the regulated community of State requirements and also help EPA in its oversight of State programs. These requirements are discussed below under the section on special primacy requirements. Today, EPA is also promulgating changes to State recordkeeping and reporting requirements.

1. Special State Primacy Requirements

To ensure that the State program includes all the elements necessary for an effective and enforceable program, the State's request for approval must contain the following: (1) If the State issues waivers, the procedures and/or policies the State will use to conduct and/or evaluate vulnerability assessments; (2) the procedures/policies the State will use to allow a system to decrease its monitoring frequency; and (3) a plan that ensures that each system monitors by the end of each compliance period.

In general, commenters supported the proposed primacy requirements. However, one commenter characterized the provisions as "resource constraining," "confusing," "redundant," "cumbersome," and "not necessary." Several commenters were concerned about the resource impact of vulnerability assessments on State programs. Several States desired sufficient flexibility to tailor monitoring requirements to site-specific conditions. Another commenter urged the Agency to allow "area wide" or geographic vulnerability determinations.

EPA has made several changes to address the commenters' concerns. First, as described elsewhere in today's rule, EPA has adopted a standard monitoring framework which synchronizes monitoring schedules and standardizes monitoring requirements. These changes should reduce the confusion and redundancy cited by one commenter. One of the changes EPA is promulgating, which is described in the section on

monitoring, is shifting the responsibility for conducting vulnerability assessments from the State to the system. The State retains, however, the responsibility to approve the results of vulnerability assessments and to issue waivers. EPA believes that this change, in part, addresses the resource constraint issue cited by the commenters. States, by implementing the standard monitoring framework and by issuing waivers, will be able to tailor monitoring requirements to site-specific conditions in most cases. EPA will allow States to issue "geographic" or "area wide" waivers. This change is also described in the section on monitoring.

The special primacy requirements have been revised to establish criteria for State descriptions of the waiver programs the State will administer. EPA will develop detailed guidance for use by Regional Administrators in reviewing primary applications, and in administering this rule in non-primacy States. As insurance against State 'abuse of discretion' in reducing individual sampling frequency requirements, EPA added § 142.16(f) to establish authority for federal rescission of State waivers that do not meet the criteria established in §§ 141.23, 141.24, and 141.40.

To encourage careful planning of the framework's implementation, EPA has added a special primacy provision in today's rule that requires the development of State monitoring plans that are enforceable under State law. EPA is making this change to ensure that all water systems complete monitoring (or conduct a vulnerability assessment) by the end of each three-year compliance period. In general, State monitoring plans should require approximately one-third of the systems to monitor each year during each three-year compliance period to provide for an even flow of samples through State-certified laboratories. States will be able to establish their own criteria to schedule the systems to monitor. If a State does not have primacy for today's provision at the time the initial compliance period begins (i.e., January 1, 1993), then EPA will be the primacy agent. Because water systems may be confused as to when each system must monitor, EPA has established procedures (§§ 141.23(k), 141.24(f)(23), and 141.24(h)(18)) that require systems to monitor at the time designated by the State. If EPA implements today's provisions because a State has not yet adopted the regulatory requirements in today's rule, EPA intends to use the State's monitoring schedule to schedule systems during each compliance period.

EPA believes this approach will reduce confusion over when each system monitors once the State adopts today's requirements.

2. State Recordkeeping Requirements

In §§ 141.16(d)(11) through 142.16(d)(16), EPA proposed that States would maintain records of: (1) Each vulnerability determination and its basis; (2) each approval of reduced monitoring and its basis; (3) each determination that a system must perform repeat monitoring for asbestos and its basis; (4) each decision that a system must monitor unregulated contaminants; (5) each letter from a system serving fewer than 150 service connections that it is available for monitoring of unregulated contaminants; and (6) annual certifications that acrylamide and epichlorohydrin are used within Federal limits for the combination of dose and monomer levels. EPA also requested comment on whether the existing record retention requirement of 40 years is reasonable, or should be modified.

In general, commenters (mostly States) characterized the proposed recordkeeping requirements as "absurd," "terrible," "excessively burdensome," and "unwarranted." The most substantive comments are listed below. EPA has revised this part to conform to the standard monitoring framework, and to provide auditable records during Federal oversight reviews.

One commenter said that the unduly diverse and complex sampling periods will exacerbate the complexity of the record/file systems. In response, the Agency notes that the sampling periods have been consolidated into the Standard Monitoring Framework, in order to simplify the program requirements for local, State, and federal personnel. This framework consists of repeating three-year compliance periods within repeating nine-year compliance cycles.

Another commenter stated that maintaining documentation of assessments resulting in non-vulnerable status or reduced sampling frequencies is less important than addressing CWSs with real problems. System by system documentation of vulnerability assessments is unnecessary; State summaries of each assessment should suffice. Many States either have inadequate resources to manage complex record systems, or will have to divert resources from more important activities, such as technical assistance for small communities.

In response, EPA does not disagree with the commenter's priorities, but the

Agency also believes that a precise record of each decision affecting public health is necessary. The commenter should note that States are not required to conduct vulnerability assessments, and States may reduce the resource impact of these regulations by applying uniform monitoring requirements to all CWSs. However, if vulnerability assessments are used as the basis for granting waivers from the uniform monitoring requirements, there must be complete documentation of those assessments and the basis for each decision. In the final rule, EPA has clarified that records of only the most recent assessment and monitoring frequency determination need be maintained.

One commenter stated that since authority to enter and inspect is a primacy requirement under § 142.10(b)(8)(iii), the requirement for records of sampling availability letters and the letters themselves, is superfluous. In response, EPA agrees with this comment, and has deleted the State recordkeeping requirement of systems which serve less than 150 service connections which send letters of availability.

Another comment asserted that annual certifications of proper acrylamide and epichlorohydrin applications are unnecessary; the application requirements should be sufficient.

In response, EPA believes the requirement is a reasonable means of attempting to confirm proper application of these chemicals, considering that the minimum frequency for sanitary survey is five years.

Another commenter pointed out that the 40-year record retention requirement is an unreasonable burden on State resources.

In response, EPA has reduced the standard monitoring records retention requirement to 12 years. This covers a nine-year monitoring cycle plus a three year monitoring period, to allow time for more current records to replace older records.

3. State Reporting Requirements

In §§ 142.15(a)(12) through 142.15(a)(17), EPA proposed that States would report lists of: (1) Systems for which vulnerability assessments have been conducted, the assessment results and their bases; (2) systems that have been permitted to reduce their monitoring frequencies, the bases for the reduction, and the new frequencies; (3) systems that must conduct repeat monitoring for asbestos; (4) systems serving fewer than 150 service

connections that have notified the State of their availability for sampling of unregulated contaminants and (5) systems that have certified compliance with treatment requirements for acrylamide and epichlorohydrin. EPA also proposed that States report the results of monitoring for unregulated contaminants.

Generally, commenters characterized the proposed rule as "redundant," "useless," "onerous," "excessive," "burdensome," "unnecessary," and "inconsistent with other reporting requirements."

In addition, many comments raised the following points:

- The appropriate vehicles for EPA oversight are review of primacy applications and annual on-site program management audits.
- The proposed reporting requirements are redundant to those activities and therefore inappropriate.
- EPA's need for, or prospective use of, the data to be reported is unclear.
- Reporting should be standardized with other rules, and conducted through a computerized data base.

In response, EPA agrees with these points after reviewing the Agency's information needs. EPA has determined that the core reporting requirements of the Primacy Rule, December 20, 1988, are sufficient for purposes of routine program oversight. Therefore, the Agency has deleted the proposed reporting requirements, except for the requirement to report results of monitoring for unregulated contaminants in § 142.15(a)(15). These results are needed for development of future MCLs.

V. Economic Analysis

Executive Order 12291 requires EPA and other regulatory agencies to perform a Regulatory Impact Analysis (RIA) for all "major" regulations, which are defined as those regulations which impose an annual cost to the economy of \$100 million or more, or meet other criteria. The Agency has determined that this action constitutes a "major" regulatory action for the purposes of the Executive Order. Therefore, in accordance with the Executive Order, the Agency has conducted an assessment of the benefits and costs of both the proposed and final rules.

The RIAs supporting the proposed rule (see "Regulatory Impact Analysis of Proposed Inorganic Chemical Regulations," March 31, 1988, and "Regulatory Impact Analysis of Proposed Synthetic Organic Chemical Regulations," April 1989) estimated an

incremental annualized cost to the nation of \$42 million for treatment and waste disposal. Monitoring costs for the proposed rule were estimated to be about \$29 million/year incrementally. Thus, the total incremental annualized cost to the nation of the proposed requirements was about \$71 million/year. In addition, unregulated contaminants were estimated to result in a one-time cost of \$42 million.

In response to public comments and receipt of new data or information, EPA made several changes to the proposed rule which resulted in an overall increase in the projected compliance costs for the final rule. In addition, revised unit cost and occurrence data were incorporated into the final RIAs. These changes, and their corresponding effects on the original cost estimates are described below. The cost of compliance for aldicarb, aldicarb sulfoxide, aldicarb sulfone, barium and pentachlorophenol continue to be included in the RIA supporting today's rule.

A. Cost of Final Rule

Table 28 shows the results of the Regulatory Impact Analyses which support today's final rule. MCLs promulgated in today's rule for barium, chromium, and selenium are all less stringent than existing National Interim Primary Drinking Water Regulations (NIPDWR). As a result, the incremental annualized treatment and waste disposal cost of \$64 million/year are associated with the more stringent MCLs for cadmium and the SOC's which are promulgated in today's final rule. Incremental monitoring costs are estimated to be about \$24 million/year. Thus, the incremental annualized compliance cost to the nation of about \$88 million/year is somewhat higher than the \$71 million/year estimated for the proposed rule. In addition, unregulated contaminants are expected to result in a one-time cost of \$39 million, which is lower than the \$42 million estimated for the proposal.

Approximately 3,242 community and non-transient, non-community water systems are not currently in compliance with existing NIPDWRs and would not be in compliance with this rule either. As a result, these systems will incur compliance costs associated with enforcement of today's rule. The cost of these 3,242 systems to come into compliance would be \$866 million per year for treatment and waste disposal and \$1.5 million per year for monitoring.

TABLE 28.—SUMMARY ESTIMATES FOR FINAL IOC AND SOC REGULATIONS

	SOC estimates	IOC estimates	Total
Systems in Violation.....	3,110	165	3,265
Costs (millions/yr):			
Compliance Costs.....	\$78	\$10	\$88
—Monitoring.....	21	2.5	24
—Treatment and Waste Disposal Costs at 3%.....	\$57	7.0	64
Unregulated Contaminant Costs (\$M).....			39
State Implementation Costs Initial (\$M).....			21
Outyear (\$M/yr).....			17
Benefits:			
Population With Reduced Exposure (millions).....	2.7	0.2	2.9
Cancer Cases.....	72		72

¹ Includes an estimated 525 systems which will violate the proposed MCL for pentachlorophenol.
² Includes \$19 million to treat for pentachlorophenol, which is being repropoed elsewhere today in the Federal Register.

Table 28 also shows the benefits of today's final rule. Compliance with the IOC's MCLs is expected to provide reduced exposure to almost 200,000 people resulting from lowering the MCL for cadmium. The types of health effects expected to be avoided include chronic toxic effects such as kidney toxicity. Compliance with the SOC's MCLs is expected to provide reduced exposure to almost three million people and prevent about 72 cases of cancer per year.

B. Comparison to Proposed Rule

Table 29 compares the costs and benefits of today's final rule to those estimated for the proposal. The differences in the cost estimates are attributable to a variety of changes in the rule and in the available input data used in the analyses. Among the more influential changes are the following:

1. Monitoring Requirements

As described in section III(D) of today's preamble, the monitoring requirements in today's rule are somewhat different from those included in the proposed rule. A direct comparison between the monitoring costs estimated in the proposal and those estimated for the final rule is not entirely appropriate because the costs estimated for the proposal were aggregated over nine years, whereas the costs for the final rule are aggregated over 18 years.

TABLE 29.—COMPARISON OF COSTS FOR PROPOSED AND FINAL RULES

	Proposed rule	Final
<i>Rule 1</i>		
Number of Systems	2,475	3,275
Capital Costs (\$M)	\$361	\$554
Annualized Capital Costs (\$M/YR)	24	37
Operation & Maintenance Costs (\$M/YR)	18	27
Monitoring Costs (\$M/YR)	29	24
Total Annualized Costs (\$M/YR)	71	88
Unregulated Contaminant Monitoring (\$M)	42	39
<i>State Implementation Costs:</i>		
Initial (\$M)	24	21
Out-year (\$M/YR)	14	17

¹ Includes pentachlorophenol, which is repropo-sec.

Table 29 shows that the monitoring costs for the final rule are somewhat less than the monitoring costs estimated for the proposal. This decrease is primarily due to a reduced number of systems which are expected to be vulnerable to SOC contamination. Current VOC monitoring cost estimates are expected to be higher than those estimated for the proposal for the following reasons:

- Systems are phased in more quickly in the final rule. Thus, systems previously expected to monitor only once every nine years are now expected to monitor for VOCs three times during an 18 year cycle; and
- The final rule requires all vulnerable systems to incur VOC monitoring costs once/year, whereas the proposal requires systems serving fewer than 3,300 people to incur monitoring costs only once during the nine year cycle and larger systems only incur monitoring costs twice during the nine year cycle.

2. Changes in MCLs

Although several MCLs in the final rule have changed from those that were proposed (e.g., toluene, toxaphene), only the proposed MCL for pentachlorophenol is more stringent as to result in additional impacts. The repropo-sec MCL for pentachlorophenol is 0.001 mg/l, compared to the proposed standard of 0.2 mg/l.

3. Changes in Occurrence Data

Occurrence data used in the final Phase II RIAs have been changed to include the following:

- Revisions to the NIRS groundwater occurrence estimates for barium, cadmium, chromium, mercury and selenium; and
- Additional occurrence data on pentachlorophenol provided by AWWA resulted in estimating 825 systems

would exceed the proposed MCL of 0.001 mg/l.

4. Changes in Unit Treatment Cost Estimates

Changes in system design flow assumptions resulted in revised treatment and waste disposal unit cost estimates for both IOCs and SOCs.

The combined effects of these changes are lower national treatment and waste disposal costs for IOCs, but higher national treatment and waste disposal costs for SOCs. The revised design flow assumptions directly resulted in higher household annual costs for both IOCs and SOCs.

C. Cost to Systems

Table 30 suggests that the cost impacts on water systems and consumers affected by most of the synthetic organic and inorganic contaminants are small and vary depending upon the specific chemical contaminant and the size of the public water system. Households served by serving more than 3,300 people could be subject to water bill increases of between \$5 and \$205 per year, if their systems have SOC or IOC contamination greater than the MCLs. EPA believes that these costs are affordable.

TABLE 30.—UPPER BOUND HOUSEHOLD COSTS (\$/HH/YEAR)

System size (population served)	SOCs ¹	IOCs ²
25-100	\$598	\$896
101-500	233	442
3,300-10,000	64	122
25,000-50,000	42	167
over 1,000,000	31	205

¹ Granular Activated Carbon or Packed Tower Aeration.

² Weighted average based on probabilities associated with alternative treatments (i.e., conventional, lime softening, ion exchange, reverse osmosis, activated alumina, activated carbon and others).

Small systems, those serving fewer than 500 people, incur higher per household costs because they do not benefit from engineering economies of scale. Households served by these small systems would have to pay significantly more, should their system have SOC or IOC contamination greater than the proposed MCL. In the case of SOCs, typical annual water bills could increase by as much as \$598, which EPA believes may not be affordable. In the case of IOCs, water bills in small supplies could climb an additional \$896 per year in contaminated systems.

D. Cost to State Programs

In 1988 EPA and the Association of State Drinking Water Administrators

(ASDWA) conducted a survey of State primacy program resource needs for implementing the 1986 SDWA amendments. The State implementation costs for the proposal were estimated to be about \$14 million per year, after an initial cost of \$24 million. The survey results have since been updated to include additional respondents. Thus, the revised State implementation costs for today's final rule is estimated to be about \$21 million initially and \$17 million/year in the out-years.

Over half of the initial and out-year costs are expected to be associated with expanding laboratory capabilities for analyzing samples. After laboratory expansion, development of vulnerability criteria, revising State primacy agreements, training staff on the rules, modifying the data management system, educating the public on the rules, and formal enforcement of the rules are each expected to require about one million dollars initially to be implemented. With respect to out-year costs, formal enforcement and public education are expected to require the most resources after laboratory expansion costs.

The State survey results for the Phase II requirements are based on the proposal; however, the survey questionnaire was carefully reviewed to determine if the estimated costs should be revised. This review indicated that the estimated State implementation costs for the proposal should not be significantly different from those expected for the final rule.

V. Other Requirements

A. Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) requires EPA to consider the effect of regulations on small entities [5 U.S.C. 602 *et seq.*]. If there is a significant effect on a substantial number of small systems, the Agency must prepare a RFA describing significant alternatives that would minimize the impact on small entities. The Agency had determined that the proposed rule, if promulgated, would not have a significant effect on a substantial number of small entities.

The RFA for the final rule indicates that of 199,390 community and non-community water supplies serving fewer than 50,000 people, about 6,473 (3.2%) are estimated to exceed the final MCLs promulgated in today's rule. Compliance costs estimated for the 6,473 systems required to install treatment are about \$313 million per year. Because of the nitrates monitoring requirements, all 199,390 systems are estimated to comply with the monitoring requirements. The monitoring costs for these small systems

are estimated to be about \$4 million/year for LOCs and about \$20 million/year for SOC. Based on the RFA results, EPA has determined that the 6,473 systems required to install treatment will be significantly affected by this rule.

While a "substantial" number of the small water supplies serving fewer than 50,000 persons will be affected by the monitoring requirements, their production costs will not increase by five percent. Therefore, the impact on this substantial number of systems is not considered "significant" according to RFA guidelines. There are 6,473 small systems estimated to require treatment and thus, incur "significant" increases in costs. However, 6,473 systems is only 3.2% of 199,390 systems and, according to EPA guidelines for conducting RFAs, less than 20% of a regulated population is not considered a substantial number.

Despite the results of this RFA, the Agency considers several thousand systems to be substantial and has attempted to provide greater flexibility to small systems while still providing adequate protection of the public health. The most significant change to the proposed rule which reduces the burden on small systems involves standardized monitoring requirements and the opportunity for waivers. In addition, EPA has reduced some monitoring requirements for systems serving <3,300 people.

As well as these changes in the rule, the 1986 Amendments to the SDWA provide small systems with exemptions. Thus, the Agency has tried to relieve small systems as much as possible from the costs of compliance with the regulatory requirements while still providing adequate protection to the health of their consumers.

B. Paperwork Reduction Act

The information collection requirements in this rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act (44 U.S.C. 3501 *et seq.*). An Information Collection Request (ICR) document has been prepared by EPA and a copy may be obtained from: Sandy Farmer, Information Policy Branch, EPA, 401 M Street, SW. (PM-223), Washington, DC or by calling 202-382-2740.

Public reporting burden for today's final rule is estimated to average 0.7 hours per response. The entire regulated population of 200,183 systems will incur some monitoring costs for nitrates. Of the total population, 76,703 systems are expected to incur monitoring costs for contaminants other than nitrates. The total estimate is about 1.2

million hours per year. In addition, systems monitoring for unregulated contaminants are expected to incur a one-time reporting burden of 0.5 hours/response resulting in a total of 31,481 hours. The monitoring costs associated with these information collection requirements are somewhat lower than those estimated for the proposed rule. Specifically, LOC monitoring costs have increased from \$4 million/year to \$4.5 million/year. SOC monitoring costs have decreased from \$27 million/year to \$21 million/year, and the one-time monitoring costs for unregulated contaminants have decreased from \$42 million to \$39 million. The change in cost is due to the numerous changes made to the monitoring, recordkeeping, and reporting requirements that had been proposed. The information collection requirements are not effective until OMB approves them and a technical amendment to that effect is published in the *Federal Register*.

VI. Public Docket and References

All supporting materials pertinent to the promulgation of this rule are included in the Public Docket located at EPA headquarters, Washington, DC. The Public Docket is available for viewing by appointment by calling the telephone number at the beginning of this notice. All public comments received on the 1986 proposal are included in the Docket.

All references cited in this notice are included in the Public Docket together with other correspondence and information.

List of Subjects in 40 CFR Parts 141, 142 and 143

Administrative practice and procedure, Chemicals, Reporting and Recordkeeping requirements, Water supply.

Dated: December 31, 1990.

F. Henry Habicht
Acting Administrator.

For the reasons set forth in the preamble, chapter I of Title 40 of U.S. Code of Federal Regulations is proposed to be amended as follows:

PART 141—NATIONAL PRIMARY DRINKING WATER REGULATIONS

1. The authority citation for part 141 continues to read as follows:

Authority: 42 U.S.C. 300f, 300g-1, 300g-2, 300g-3, 300g-4, 300g-5, 300g-6, 300j-4 and 300j-9.

2. Section 141.2 is amended by adding, in alphabetical order, definitions for "Compliance cycle," "Compliance period," "Initial compliance period," and

"repeat compliance period" to read as follows:

§ 141.2 Definitions.

Compliance cycle means the nine-year calendar year cycle during which public water systems must monitor. Each compliance cycle consists of three three-year compliance periods. The first calendar year cycle begins January 1, 1993 and ends December 31, 2001; the second begins January 1, 2002 and ends December 31, 2010; the third begins January 1, 2011 and ends December 31, 2019.

Compliance period means a three-year calendar year period within a compliance cycle. Each compliance cycle has three three-year compliance periods. Within the first compliance cycle, the first compliance period runs from January 1, 1993 to December 31, 1995; the second from January 1, 1996 to December 31, 1998; the third from January 1, 1999 to December 31, 2001.

Initial compliance period means the first full three-year compliance period which begins at least 18 months after promulgation.

Repeat compliance period means any subsequent compliance period after the initial compliance period.

3. In § 141.11, paragraph (b) is amended by removing the entry for "silver" from the table, and by revising the introductory text of paragraph (b) to read as follows:

§ 141.11 Maximum contaminant levels for inorganic chemicals.

(b) The following maximum contaminant levels for cadmium, chromium, mercury, nitrate, and selenium shall remain effective until July 30, 1992.

3. Section 141.12 is revised to read as follows:

§ 141.12 Maximum contaminant levels for organic chemicals.

The following are the maximum contaminant levels for organic chemicals. The maximum contaminant levels for organic chemicals in paragraph (a) of this section apply to all community water systems. Compliance with the maximum contaminant level in paragraph (a) of this section is calculated pursuant to § 141.24. The maximum contaminant level for total trihalomethanes in paragraph (c) of this section applies only to community water systems which serve a population of

10,000 or more individuals and which add a disinfectant (oxidant) to the water in any part of the drinking water treatment process. Compliance with the maximum contaminant level for total trihalomethanes is calculated pursuant to § 141.30.

	Level, milligrams per liter
(a) Chlorinated hydrocarbons: Endrin (1,2,3,4,10,10-hexachloro-8,7-epoxy-1,4, 4a,5,6,7,8,81-octahydro-1,4-endo, endo-5,8-dimethano naphthalene).....	0.0002
(b) (Reserved).....	
(c) Total trihalomethanes (the sum of the concentrations of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform)).....	0.1

4. Section 141.23 is revised to read as follows:

§ 141.23 Inorganic chemical sampling and analytical requirements.

Community water systems shall conduct monitoring to determine compliance with the maximum contaminant levels specified in § 141.62 in accordance with this section. Non-transient, non-community water systems shall conduct monitoring to determine

compliance with the maximum contaminant levels specified in § 141.62 in accordance with this section. Transient, non-community water systems shall conduct monitoring to determine compliance with the nitrate and nitrite maximum contaminant levels in § 141.11 and § 141.62 (as appropriate) in accordance with this section.

(a) Monitoring shall be conducted as follows:

(1) Groundwater systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point) beginning in the compliance period starting January 1, 1993. The system shall take each sample at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(2) Surface water systems shall take a minimum of one sample at every entry point to the distribution system after any application of treatment or in the distribution system at a point which is representative of each source after treatment (hereafter called a sampling point) beginning in the compliance period beginning January 1, 1993. The system shall take each sample at the

same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

Note: For purposes of this paragraph, surface water systems include systems with a combination of surface and ground sources.

(3) If a system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

(4) The State may reduce the total number of samples which must be analyzed by allowing the use of compositing. Composite samples from a maximum of five sampling points are allowed. Compositing of samples must be done in the laboratory.

(i) If the concentration in the composite sample is greater than or equal to the detection limit of any inorganic chemical, then a follow-up sample must be taken within 14 days at each sampling point included in the composite. These samples must be analyzed for the contaminants which were detected in the composite sample. Detection limits for each analytical method are the following:

DETECTION LIMITS FOR INORGANIC CONTAMINANTS

Contaminant	MCL (mg/l)		Detection limit (mg/l)
Asbestos	7 MLF ¹	Transmission Electron Microscopy	0.01 MFL
Barium	2	Atomic Absorption; furnace technique	0.002
		Atomic Absorption; direct aspiration	0.1
		Inductively Coupled Plasma	0.002 (0.001) ¹
Cadmium	0.005	Atomic Absorption; furnace technique	0.0001
		Inductively Coupled Plasma	0.001 ¹
Chromium	0.1	Atomic Absorption; furnace technique	0.001
		Inductively Coupled Plasma	0.007 (0.001) ¹
Mercury	0.002	Manual Cold Vapor Technique	0.0002
		Automated Cold Vapor Technique	0.0002
Nitrate	10 (as N)	Manual Cadmium Reduction	0.01
		Automated Hydrazine Reduction	0.05
		Automated Cadmium Reduction	1
		Ion Selective Electrode	0.01
Nitrite	1 (as N)	Ion Chromatography	0.01
		Spectrophotometric	0.05
		Automated Cadmium Reduction	0.01
		Manual Cadmium Reduction	0.004
Selenium	0.05	Ion Chromatography	0.002
		Atomic Absorption; furnace	0.002
		Atomic Absorption; gaseous hydride	0.002

¹ Using concentration technique in Appendix A to EPA Method 200.7.

² MFL = million fibers per liter > 10 µm.

(ii) If the population served by the system is >3,300 persons, then compositing may only be permitted by the State at sampling points within a single system. In systems serving <3,300 persons, the State may permit compositing among different systems

provided the 5-sample limit is maintained.

(5) The frequency of monitoring for asbestos shall be in accordance with paragraph (b) of this section; the frequency of monitoring for barium, cadmium, chromium, fluoride, mercury, and selenium shall be in accordance

with paragraph (c) of this section; the frequency of monitoring for nitrate shall be in accordance with paragraph (d) of this section; and the frequency of monitoring for nitrite shall be in accordance with paragraph (e) of this section.

(b) The frequency of monitoring conducted to determine compliance with the maximum contaminant level for asbestos specified in § 141.62(b) shall be conducted as follows:

(1) Each community and non-transient, non-community water system is required to monitor for asbestos during the first three-year compliance period of each nine-year compliance cycle beginning in the compliance period starting January 1, 1993.

(2) If the system believes it is not vulnerable to either asbestos contamination in its source water or due to corrosion of asbestos-cement pipe, or both, it may apply to the State for a waiver of the monitoring requirement in paragraph (b)(1) of this section. If the State grants the waiver, the system is not required to monitor.

(3) The State may grant a waiver based on a consideration of the following factors:

(i) Potential asbestos contamination of the water source, and

(ii) The use of asbestos-cement pipe for finished water distribution and the corrosive nature of the water.

(4) A waiver remains in effect until the completion of the three-year compliance period. Systems not receiving a waiver must monitor in accordance with the provisions of paragraph (b)(1) of this section.

(5) A system vulnerable to asbestos contamination due solely to corrosion of asbestos-cement pipe shall take one sample at a tap served by asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur.

(6) A system vulnerable to asbestos contamination due solely to source water shall monitor in accordance with the provision of paragraph (a) of this section.

(7) A system vulnerable to asbestos contamination due both to its source water supply and corrosion of asbestos-cement pipe shall take one sample at a tap served by asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur.

(8) A system which exceeds the maximum contaminant levels as determined in § 141.23(i) of this section shall monitor quarterly beginning in the next quarter after the violation occurred.

(9) The State may decrease the quarterly monitoring requirement to the frequency specified in paragraph (b)(1) of this section provided the State has determined that the system is reliably and consistently below the maximum contaminant level. In no case can a State make this determination unless a groundwater system takes a minimum of two quarterly samples and a surface (or

combined surface/ground) water system takes a minimum of four quarterly samples.

(10) If monitoring data collected after January 1, 1990 are generally consistent with the requirements of § 141.23(b), then the State may allow systems to use that data to satisfy the monitoring requirement for the initial compliance period beginning January 1, 1993.

(c) The frequency of monitoring conducted to determine compliance with the maximum contaminant levels in § 141.62 for barium, cadmium, chromium, fluoride, mercury, and selenium shall be as follows:

(1) Groundwater systems shall take one sample at each sampling point during each compliance period beginning in the compliance period starting January 1, 1993. Surface water systems (or combined surface/ground) shall take one sample annually at each sampling point beginning January 1, 1993.

(2) The system may apply to the State for a waiver from the monitoring frequencies specified in paragraph (c)(1) of this section.

(3) A condition of the waiver shall require that a system shall take a minimum of one sample while the waiver is effective. The term during which the waiver is effective shall not exceed one compliance cycle (i.e., nine years).

(4) The State may grant a waiver provided surface water systems have monitored annually for at least three years and groundwater systems have conducted a minimum of three rounds of monitoring. (At least one sample shall have been taken since January 1, 1990). Both surface and groundwater systems shall demonstrate that all previous analytical results were less than the maximum contaminant level. Systems that use a new water source are not eligible for a waiver until three rounds of monitoring from the new source have been completed.

(5) In determining the appropriate reduced monitoring frequency, the State shall consider:

(i) Reported concentrations from all previous monitoring;

(ii) The degree of variation in reported concentrations; and

(iii) Other factors which may affect contaminant concentrations such as changes in groundwater pumping rates, changes in the system's configuration, changes in the system's operating procedures, or changes in stream flows or characteristics.

(6) A decision by the State to grant a waiver shall be made in writing and shall set forth the basis for the determination. The determination may

be initiated by the State or upon an application by the public water system. The public water system shall specify the basis for its request. The State shall review and, where appropriate, revise its determination of the appropriate monitoring frequency when the system submits new monitoring data or when other data relevant to the system's appropriate monitoring frequency become available.

(7) Systems which exceed the maximum contaminant levels as calculated in § 141.23(i) of this section shall monitor quarterly beginning in the next quarter after the violation occurred.

(8) The State may decrease the quarterly monitoring requirement to the frequencies specified in paragraphs (c)(1) and (c)(2) of this section provided it has determined that the system is reliably and consistently below the maximum contaminant level. In no case can a State make this determination unless a groundwater system takes a minimum of two quarterly samples and a surface water system takes a minimum of four quarterly samples.

(d) All public water systems (community; non-transient, non-community; and transient, non-community systems) shall monitor to determine compliance with the maximum contaminant level for nitrate in § 141.62.

(1) Community and non-transient, non-community water systems served by groundwater systems shall monitor annually beginning January 1, 1993; systems served by surface water shall monitor quarterly beginning January 1, 1993.

(2) For community and non-transient, non-community water systems, the repeat monitoring frequency for groundwater systems shall be quarterly for at least one year following any one sample in which the concentration is >50 percent of the MCL. The State may allow a groundwater system to reduce the sampling frequency to annually after four consecutive quarterly samples are reliably and consistently less than the MCL.

(3) For community and non-transient, non-community water systems, the State may allow a surface water system to reduce the sampling frequency to annually if all analytical results from four consecutive quarters are <50 percent of the MCL. A surface water system shall return to quarterly monitoring if any one sample is >50 percent of the MCL.

(4) Each transient non-community water system shall monitor annually beginning January 1, 1993.

(5) After the initial round of quarterly sampling is completed, each community and non-transient non-community system which is monitoring annually shall take subsequent samples during the quarter(s) which previously resulted in the highest analytical result.

(e) All public water systems (community; non-transient, non-community; and transient, non-community systems) shall monitor to determine compliance with the maximum contaminant level for nitrite in § 141.82(b).

(1) All public water systems shall take one sample at each sampling point in the compliance period beginning January 1, 1993 and ending December 31, 1995.

(2) After the initial sample, systems where an analytical result for nitrite is <50 percent of the MCL shall monitor at the frequency specified by the State.

(3) For community, non-transient, non-community, and transient non-community water systems, the repeat monitoring frequency for any water system shall be quarterly for at least one year following any one sample in which the concentration is >50 percent of the MCL. The State may allow a system to reduce the sampling frequency to annually after determining the system is reliably and consistently less than the MCL.

(4) Systems which are monitoring annually shall take each subsequent sample during the quarter(s) which previously resulted in the highest analytical result.

(f) Confirmation samples:

(1) Where the results of sampling for asbestos, barium, cadmium, chromium, fluoride, mercury, or selenium indicate an exceedance of the maximum contaminant level, the State may require that one additional sample be collected as soon as possible after the initial sample was taken (but not to exceed two weeks) at the same sampling point.

(2) Where nitrate or nitrite sampling results indicate an exceedance of the maximum contaminant level, the system shall take a confirmation sample within 24 hours of the system's receipt of notification of the analytical results of the first sample. Systems unable to comply with the 24-hour sampling requirement must immediately notify the consumers served by the area served by the public water system in accordance with § 141.32. Systems exercising this option must take and analyze a confirmation sample within two weeks of notification of the analytical results of the first sample.

(3) If a State-required confirmation sample is taken for any contaminant, then the results of the initial and confirmation sample shall be averaged. The resulting average shall be used to determine the system's compliance in accordance with paragraph (i) of this section. States have the discretion to delete results of obvious sampling errors.

(g) The State may require more frequent monitoring than specified in paragraphs (b), (c), (d) and (e) of this section or may require confirmation samples for positive and negative results at its discretion.

(h) Systems may apply to the State to conduct more frequent monitoring than the minimum monitoring frequencies specified in this section.

(i) Compliance with §§ 141.11 or 141.82(b) (as appropriate) shall be determined based on the analytical result(s) obtained at each sampling point.

(1) For systems which are conducting monitoring at a frequency greater than annual, compliance with the maximum contaminant levels for asbestos, barium, cadmium, chromium, fluoride, mercury, and selenium is determined by a running annual average at each sampling point. If the average at any sampling point is

greater than the MCL, then the system is out of compliance. If any one sample would cause the annual average to be exceeded, then the system is out of compliance immediately. Any sample below the detection limit shall be calculated at zero for the purpose of determining the annual average.

(2) For systems which are monitoring annually, or less frequently, the system is out of compliance with the maximum contaminant levels for asbestos, barium, cadmium, chromium, fluoride, mercury and selenium if the level of a contaminant at any sampling point is greater than the MCL. If a confirmation sample is required by the State, the determination of compliance will be based on the average of the two samples.

(3) Compliance with the maximum contaminant levels for nitrate and nitrite is determined based on one sample if the levels of these contaminants are below the MCLs. If the levels of nitrate and/or nitrite exceed the MCLs in the initial sample, a confirmation sample is required in accordance with paragraph (f)(2) of this section, and compliance shall be determined based on the average of the initial and confirmation samples.

(4) If a public water system has a distribution system separable from other parts of the distribution system with no interconnections, the State may allow the system to give public notice to only the area served by that portion of the system which is out of compliance.

(j) Each public water system shall monitor at the time designated by the State during each compliance period.

(k) Inorganic analysis:

(1) Analysis for asbestos, barium, cadmium, chromium, mercury, nitrate, nitrite, and selenium shall be conducted using the following methods:

INORGANIC CONTAMINANTS ANALYTICAL METHODS

Contaminant	Methodology ¹¹	EPA ¹	Reference (method No.)		
			ASTM ²	SM ³	Other
Asbestos	Transmission Electron Microscopy	EPA ⁴			
Barium	Atomic absorption; furnace technique	208.2		304	
	Atomic absorption; direct aspiration	208.1		303C	
	Inductively-coupled plasma	200.7 ^{1,6}			
Cadmium	Atomic absorption; furnace technique	213.2		304	
	Inductively-coupled plasma	260.7A ⁶			
Chromium	Atomic absorption; furnace technique	218.2		304 ⁷	
	Inductively-coupled plasma	200.7 ^{1,6}			
Mercury	Manual cold vapor technique	243.1	D3223-80	303F	
	Automated cold vapor technique	245.2			
Nitrate	Manual cadmium reduction	353.3	D3657-85E	418C	
	Automated hydrazine reduction	353.1			
	Automated cadmium reduction	353.2	D3657-85A	418F	
	Ion selective electrode				WwwWG/5880 ¹
	Ion chromatography	300.0			B-1021 ¹⁰
Nitrite	Spectrophotometric	354.1			

INORGANIC CONTAMINANTS ANALYTICAL METHODS—Continued

Contaminant	Methodology ¹	EPA ¹	Reference (method No.)		
			ASTM ²	SM ³	Other
Selenium	Automated cadmium reduction	353.2	D3867-85A	418F	
	Manual cadmium reduction	353.3	D3867-85B	418C	
	Ion chromatography	300.0			B-1011 ¹⁰
	Atomic absorption; gaseous hydride	270.3	D3859-84A	303E	I-3667-85 ⁴
	Atomic absorption; furnace technique	270.2	D3859-84B	304 ⁵	

¹ "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268 (EPA-600/4-79-020), March 1983. Available from ORD Publications, CERL, EPA, Cincinnati, OH 45268.

² Annual Book of ASTM Standards, Vol. 11.01 American Society for Testing and Materials, 1961 Race Street, Philadelphia, PA 19103.

³ "Standard Methods for the Examination of Water and Wastewater," 16th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985.

⁴ "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," Techniques of Water-Resources Investigations of the U.S. Geological Survey Books, Chapter A1, 1985, Open-File Report 85-495. Available from Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, MS 306 Box 24525, Denver Federal Center, Denver, CO 80225.

⁵ "Orion Guide to Water and Wastewater Analysis," Form W6WWG/5880, p. 5, 1985, Orion Research, Inc., Cambridge, MA.

⁶ 200.7A "Inductively-Coupled Plasma Atomic Emission Analysis of Drinking Water," Appendix to Method 200.7, March, 1987, U.S. EPA, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

⁷ The addition of 1 mL of 30% H₂O₂ to each 100 mL of standards and samples is required before analysis.

⁸ Prior to dilution of the Se calibration standard, add 2 mL of 30% H₂O₂ for each 100 mL of standard.

⁹ "Analytical Method for Determination of Asbestos Fibers in Water," EPA-600/4-83-043, September 1983, U.S. EPA, Environmental Research Laboratory, Athens, GA 30613.

¹⁰ "Water Test Method for the Determination of Nitrite/Nitrate in Water Using Single Column Ion Chromatography," Method B-1011, Millipore Corporation, Waters Chromatography Division, 34 Maple Street, Milford, MA 01757.

¹¹ For approved analytical procedures for metals, the technique applicable to total metals must be used.

(2) Analyses for arsenic shall be conducted using the following methods: Method ¹ 206.2, Atomic Absorption Furnace Technique; or Method ¹ 206.3, or Method ⁴ D2972-78B, or Method ²

301.A VII, pp. 159-162, or Method ³ I-1062-78, pp. 61-63, Atomic Absorption—Gaseous Hydride; or Method ¹ 206.4, or Method ⁴ D-2972-78A, or Method ² 404-

A and 404-B(4), Spectrophotometric, Silver Diethyl-dithiocarbamate.

(3) Analyses for fluoride shall be conducted using the following methods:

METHODOLOGY FOR FLUORIDE

Methodology	Reference (Method No.) ¹			
	EPA ²	ASTM ³	SM ⁴	Other
Colorimetric SPADNS, with distillation	340.1	D1179-72A	43 A and C	
Potentiometric ion selective electrode	340.2	D1179-72B	413 B	
Automated Alizarin fluoride blue, with distillation (complexone)	340.3		413 E	129-71W ⁵
Automated ion selective electrode				380-75WE ¹

¹ "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268 (EPA-600/4-79-020), March 1983. Available from ORD Publications, CERL, EPA, Cincinnati, Ohio 45268. For approved analytical procedures for metals, the technique applicable to total metals must be used.

² [Reserved]

³ [Reserved]

⁴ Annual Book of ASTM Standards, part 31 Water, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

⁵ "Standard Methods for the Examination of Water and Wastewater," 16th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985.

⁶ "Fluoride in Water and Wastewater, Industrial Method = 129-71W," Technicon Industrial Systems, Tarrytown, New York 10591, December 1972.

⁷ "Fluoride in Water and Wastewater," Technicon Industrial Systems, Tarrytown, New York 10591, February 1978.

(4) Sample collection for asbestos, barium, cadmium, chromium, fluoride, mercury, nitrate, nitrite, and selenium

under this section shall be conducted using the sample preservation,

container, and maximum holding time procedures specified in the table below:

Contaminant	Preservative ¹	Container ²	Time ³
Asbestos	Cool, 4 °C	P or G	
Barium	Conc HNO ₃ to pH <2	P or G	6 months
Cadmium	Conc HNO ₃ to pH <2	P or G	6 months
Chromium	Conc HNO ₃ to pH <2	P or G	6 months
Fluoride	None	P or G	1 month

¹ "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268 (EPA-600/4-79-020), March 1979. Available from ORD Publications, CERL, EPA, Cincinnati, Ohio 45268. For approved analytical procedures for metals, the technique applicable to total metals must be used.

² "Standard Methods for the Examination of Water and Wastewater," 16th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985.

³ Techniques of Water-Resources Investigation of the United States Geological Survey, Chapter A-1, "Methods for Determination of Inorganic

Substances in Water and Fluvial Sediments," Book 8, 1978, Stock #014-001-03177-8. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

⁴ Annual Book of ASTM Standards, part 31 Water, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

Contaminant	Preservative ¹	Container ²	Time ³
Mercury	Conc HNO ₃ to pH < 2	G P	28 days. 14 days.
Nitrate:			
Chlorinated	Cool, 4 °C	P or G	28 days.
Non-chlorinated	Conc H ₂ SO ₄ to pH < 2	P or G	14 days.
Nitrite	Cool, 4 °C	P or G	48 hours.
Selenium	Conc HNO ₃ to pH < 2	P or G	6 months.

¹ If HNO₃ cannot be used because of shipping restrictions, sample may be initially preserved by icing and immediately shipping it to the laboratory. Upon receipt in the laboratory, the sample must be acidified with conc HNO₃ to pH < 2. At time of analysis, sample container should be thoroughly rinsed with 1.1 HNO₃; washings should be added to sample.

² P = plastic, hard or soft; G = glass, hard or soft.

³ In all cases, samples should be analyzed as soon after collection as possible.

(5) Analysis under this section shall only be conducted by laboratories that have received approval by EPA or the State. To receive approval to conduct analyses for asbestos, barium, cadmium, chromium, fluoride, mercury, nitrate, nitrite and selenium the laboratory must:

(i) Analyze Performance Evaluation samples which include those substances provided by EPA Environmental Monitoring and Support Laboratory or equivalent samples provided by the State.

(ii) Achieve quantitative results on the analyses that are within the following acceptance limits:

Contaminant	Acceptance limit
Asbestos	2 standard deviations based on study statistics.
Barium	±15% at ≥ 0.15 mg/L.
Cadmium	±20% at ≥ 0.002 mg/L.
Chromium	±15% at ≥ 0.01 mg/L.
Fluoride	±10% at 1 to 10 mg/L.
Mercury	±30% at ≥ 0.0005 mg/L.
Nitrate	±10% at ≥ 0.4 mg/L.
Nitrite	±15% at ≥ 0.4 mg/L.
Selenium	±20% at ≥ 0.01 mg/L.

5. In § 141.24, paragraph (a) the introductory text, paragraph (e), and paragraph (f) are revised, and a new paragraph (h) is added to read as follows:

§ 141.24 Organic chemicals other than total trihalomethanes, sampling and analytical requirements.

(a) Monitoring of endrin for purposes of determining compliance with the maximum contaminant level listed in § 141.12(a) shall be conducted as follows:

(e) Analysis made to determine compliance with the maximum contaminant level for endrin in § 141.12(a) shall be made in accordance with Method 508, "Determination of Chlorinated Pesticides in Water by Gas Chromatography with and Electron Capture Detector," in "Methods for the Determination of Organic Compounds in Drinking Water," ORD Publications,

CERI, EPA/600/4-88/039, December 1988.

(f) Analysis of the contaminants listed in § 141.61(a) (9) through (18) for the purpose of determining compliance with the maximum contaminant level shall be conducted as follows:

(1) Groundwater systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point). If conditions warrant, the State may designate additional sampling points within the distribution system or at the consumer's tap which more accurately determines consumer exposure. Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(2) Surface water systems shall take a minimum of one sample at points in the distribution system that are representative of each source or at each entry point to the distribution system after treatment (hereafter called a sampling point). If conditions warrant, the State may designate additional sampling points within the distribution system or at the consumer's tap which more accurately determines consumer exposure. Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source, treatment plant, or within the distribution system.

Note: For purposes of this paragraph, surface water systems include systems with a combination of surface and ground surfaces.

(3) If the system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water representative of all sources is being used).

(4) Each community and non-transient non-community water system shall take four consecutive quarterly samples for

each contaminant listed in § 141.61(a) (9) through (18) during each compliance period beginning in the compliance period starting January 1, 1993.

(5) Groundwater systems which do not detect one of the contaminants listed in § 141.61(a) (9) through (18) after conducting the initial round of monitoring required in paragraph (f)(4) of this section shall take one sample annually.

(6) If the initial monitoring for contaminants listed in § 141.61(a) (9) through (18) as allowed in paragraph (f)(18) of this section has been completed by December 31, 1992 and the system did not detect any contaminant listed in § 141.61(a) (1) through (18) then the system shall take one sample annually beginning January 1, 1993. After a minimum of three years of annual sampling, the State may allow groundwater systems which have no previous detection of any contaminant listed in § 141.61(a) to take one sample during each compliance period.

(7) Each community and non-transient water system which does not detect a contaminant listed in § 141.61(a) (1) through (18) may apply to the State for a waiver from the requirement of paragraph (f)(4) and (f)(5) of this section after completing the initial monitoring. (For the purposes of this section, detection is defined as >0.0005 mg/L.) A waiver shall be effective for no more than six years (two compliance periods).

(8) A State may grant a waiver after evaluating the following factor(s):

(i) Knowledge of previous use (including transport, storage, or disposal) of the contaminant within the watershed or zone of influence of the system. If a determination by the State reveals no previous use of the contaminant within the watershed or zone of influence, a waiver may be granted.

(ii) If previous use of the contaminant is unknown or it has been used previously, then the following factors shall be used to determine whether a waiver is granted.

(A) Previous analytical results.

(B) The proximity of the system to potential point or non-point source of contamination. Point sources include spills and leaks of chemicals at or near a water treatment facility or at manufacturing, distribution, or storage facilities, or from hazardous and municipal waste landfills and other waste handling or treatment facilities.

(C) The environmental persistence and transport of the contaminants.

(D) The number of persons served by the public water system and the proximity of a smaller system to a larger system.

(E) How well the water source is protected against contamination such as whether it is a surface or groundwater system. Groundwater systems must consider factors such as depth of the well, the type of soil, and wellhead protection. Surface water systems must consider watershed protection.

(7) As a condition of the waiver a system must take one sample at each sampling point during the time the waiver is effective (i.e., one sample during two compliance periods or six years), and update its vulnerability assessment considering the factors listed in paragraph (f)(8) of this section. Based on this vulnerability assessment the State must confirm that the system is non-vulnerable. If the State does not make this reconfirmation within three years of the initial determination, then the waiver is invalidated and the system is required to sample annually as specified in paragraph (f)(5) of this section.

(10) A surface water system which does not detect a contaminant listed in § 141.61(a) (1) through (18) and is determined by the State to be non-vulnerable using the criteria in paragraph (f)(8) of this section shall monitor at the frequency specified by the State (if any). Systems meeting this criteria must be determined by the State to be non-vulnerable based on a vulnerability assessment during each compliance period.

(11) If a contaminant listed in § 141.61(a) (9) through (18) is detected at a level exceeding 0.0005 mg/l in any sample, then:

(i) The system must monitor quarterly at each sampling point which resulted in a detection.

(ii) The State may decrease the quarterly monitoring requirement specified in paragraph (f)(11)(i) of this section provided it has determined that the system is reliably and consistently below the maximum contaminant level. In no case shall the State make this determination unless a groundwater system takes a minimum of two quarterly samples and a surface water

system takes a minimum of four quarterly samples.

(iii) If the State determines that the system is reliably and consistently below the MCL, the State may allow the system to monitor annually. Systems which monitor annually must monitor during the quarter(s) which previously yielded the highest analytical result.

(iv) Systems which have three consecutive annual samples with no detection of a contaminant may apply to the State for a waiver as specified in paragraph (f)(7) of this section.

(v) (Reserved)

(12) Systems which violate the requirements of § 141.61(a) (9) through (18) as determined by paragraph (f)(16) of this section must monitor quarterly. After a minimum of four quarterly samples shows the system is in compliance as specified in paragraph (f)(16) of this section, and the State determines that the system is reliably and consistently below the maximum contaminant level, the system may monitor at the frequency and time specified in paragraph (f)(11)(iii) of this section.

(13) The State may require a confirmation sample for positive or negative results. If a confirmation sample is required by the State, the result must be averaged with the first sampling result and the average is used for the compliance determination as specified by paragraph (f)(16) of this section. States have discretion to delete results of obvious sampling errors from this calculation.

(14) The State may reduce the total number of samples a system must analyze by allowing the use of compositing. Composite samples from a maximum of five sampling points are allowed. Compositing of samples must be done in the laboratory and analyzed within 14 days of sample collection.

(i) If the concentration in the composite sample is ≥ 0.0005 mg/l for any contaminant listed in § 141.61(a), then a follow-up sample must be taken and analyzed within 14 days from each sampling point included in the composite.

(ii) If duplicates of the original sample taken from each sampling point used in the composite are available, the system may use these instead of resampling. The duplicate must be analyzed and the results reported to the State within 14 days of collection.

(iii) If the population served by the system is $>3,300$ persons, then compositing may only be permitted by the State at sampling points within a single system. In systems serving $<3,300$ persons, the State may permit compositing among different systems

provided the 5-sample limit is maintained.

(iv) Compositing samples prior to GC analysis.

(A) Add 5 ml or equal larger amounts of each sample (up to 5 samples are allowed) to a 25 ml glass syringe. Special precautions must be made to maintain zero headspace in the syringe.

(B) The samples must be cooled at 4° C during this step to minimize volatilization losses.

(C) Mix well and draw out a 5-ml aliquot for analysis.

(D) Follow sample introduction, purging, and desorption steps described in the method.

(E) If less than five samples are used for compositing, a proportionately small syringe may be used.

(v) Compositing samples prior to GC/MS analysis.

(A) Inject 5-ml or equal larger amounts of each aqueous sample (up to 5 samples are allowed) into a 25-ml purging device using the sample introduction technique described in the method.

(B) The total volume of the sample in the purging device must be 25 ml.

(C) Purge and desorb as described in the method.

(15) Compliance with § 141.61(a) (9) through (18) shall be determined based on the analytical results obtained at each sampling point.

(i) For systems which are conducting monitoring at a frequency greater than annual, compliance is determined by a running annual average of all samples taken at each sampling point. If the annual average of any sampling point is greater than the MCL, then the system is out of compliance. If the initial sample or a subsequent sample would cause the annual average to be exceeded, then the system is out of compliance immediately. Any samples below the detection limit shall be calculated as zero for purposes of determining the annual average.

(ii) If monitoring is conducted annually, or less frequently, the system is out of compliance if the level of a contaminant at any sampling point is greater than the MCL. If a confirmation sample is required by the State, the determination of compliance will be based on the average of two samples.

(iii) If a public water system has a distribution system separable from other parts of the distribution system with no interconnections, the State may allow the system to give public notice to only that area served by that portion of the system which is out of compliance.

(16) Analysis for the contaminants listed in § 141.61(a) (9) through (18) shall

be conducted using the following EPA methods or their equivalent as approved by EPA. These methods are contained in "Methods for the Determination of Organic Compounds in Drinking Water", ORD Publications, CERL EPA/600/4-88/039, December 1988. These documents are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. The toll-free number is 800-338-4700.

(i) Method 502.1, "Volatile Halogenated Organic Chemicals in Water by Purge and Trap Gas Chromatography."

(ii) Method 502.2, "Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Series."

(iii) Method 503.1, "Volatile Aromatic and Unsaturated Organic Compounds in Water by Purge and Trap Gas Chromatography."

(iv) Method 524.1, "Measurement of Purgeable Organic Compounds in Water by Purged Column Gas Chromatography/Mass Spectrometry."

(v) Method 524.2, "Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry."

(17) Analysis under this section shall only be conducted by laboratories that have received approval by EPA or the State according to the following conditions:

(i) To receive conditional approval to conduct analyses for the contaminants in § 141.61(a) (9) through (18) the laboratory must:

(A) Analyze Performance Evaluation samples which include these substances provided by EPA Environmental Monitoring and Support Laboratory or equivalent samples provided by the State.

(B) Achieve the quantitative acceptance limits under paragraphs (f)(18)(i) (C) and (D) of this section for at least 80 percent of the regulated organic chemicals listed in § 141.61(a) (2) through (18).

(C) Achieve quantitative results on the analyses performed under paragraph (f)(18)(i)(A) of this section that are within ± 20 percent of the actual amount of the substances in the Performance Evaluation sample when the actual amount is greater than or equal to 0.010 mg/l.

(D) Achieve quantitative results on the analyses performed under paragraph (f)(18)(i)(A) of this section that are within ± 40 percent of the actual amount of the substances in the Performance Evaluation sample when the actual amount is less than 0.010 mg/l.

(E) Achieve a method detection limit of 0.0005 mg/l, according to the procedures in Appendix B of part 136 of this chapter.

(F) Be currently approved by EPA or the State for the analyses of trihalomethanes under § 141.30.

(ii) [Reserved]

(18) States may allow the use of monitoring data collected after January 1, 1988 required under section 1445 of the Act for purposes of monitoring compliance. If the data are generally consistent with the other requirements in this section, the State may use those data (i.e., a single sample rather than four quarterly samples) to satisfy the initial monitoring requirement of paragraph (f)(4) of this section.

(19) States may increase required monitoring where necessary to detect variations within the system.

(20) Each approved laboratory must determine the method detection limit (MDL), as defined in Appendix B to Part 136 of this chapter, at which it is capable of detecting VOCs. The acceptable MDL is 0.0005 mg/l. This concentration is the detection concentration for purposes of this section.

(21) Each public water system shall monitor at the time designated by the State within each compliance period.

(h) Analysis of the contaminants listed in § 141.61(c) for the purposes of determining compliance with the maximum contaminant level shall be conducted as follows:

(1) Groundwater systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(2) Surface water systems shall take a minimum of one sample at points in the distribution system that are representative of each source or at each entry point to the distribution system after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

Note: For purposes of this paragraph, surface water systems include systems with a combination of surface and ground sources.

(3) If the system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of

normal operating conditions (i.e., when water representative of all sources is being used).

(4) Monitoring frequency:

(i) Each community and non-transient non-community water system shall take four consecutive quarterly samples for each contaminant listed in § 141.61(c) during each compliance period beginning with the compliance period starting January 1, 1993.

(ii) Systems serving more than 3,300 persons which do not detect a contaminant in the initial compliance period may reduce the sampling frequency to a minimum of two quarterly samples in one year during each repeat compliance period.

(iii) Systems serving less than or equal to 3,300 persons which do not detect a contaminant in the initial compliance period may reduce the sampling frequency to a minimum of one sample during each repeat compliance period.

(5) Each community and non-transient water system may apply to the State for a waiver from the requirement of paragraph (h)(4) of this section. A system must reapply for a waiver for each compliance period.

(6) A State may grant a waiver after evaluating the following factor(s): Knowledge of previous use (including transport, storage, or disposal) of the contaminant within the watershed or zone of influence of the system. If a determination by the State reveals no previous use of the contaminant within the watershed or zone of influence, a waiver may be granted. If previous use of the contaminant is unknown or it has been used previously, then the following factors shall be used to determine whether a waiver is granted.

(i) Previous analytical results.

(ii) The proximity of the system to a potential point or non-point source of contamination. Point sources include spills and leaks of chemicals at or near a water treatment facility or at manufacturing, distribution, or storage facilities, or from hazardous and municipal waste landfills and other waste handling or treatment facilities. Non-point sources include the use of pesticides to control insect and weed pests on agricultural areas, forest lands, home and gardens, and other land application uses.

(iii) The environmental persistence and transport of the pesticide or PCBs.

(iv) How well the water source is protected against contamination due to such factors as depth of the well and the type of soil and the integrity of the well casing.

(v) Elevated nitrate levels at the water supply source.

(vi) Use of PCBs in equipment used in the production, storage, or distribution of water (i.e., PCBs used in pumps, transformers, etc.).

(7) If an organic contaminant listed in § 141.61(c) is detected (as defined by paragraph (h)(18) of this section) in any sample, then:

(i) Each system must monitor quarterly at each sampling point which resulted in a detection.

(ii) The State may decrease the quarterly monitoring requirement specified in paragraph (h)(7)(i) of this section provided it has determined that the system is reliably and consistently below the maximum contaminant level. In no case shall the State make this determination unless a groundwater system takes a minimum of two quarterly samples and a surface water system takes a minimum of four quarterly samples.

(iii) After the State determines the system is reliably and consistently below the maximum contaminant level the State may allow the system to monitor annually. Systems which monitor annually must monitor during the quarter that previously yielded the highest analytical result.

(iv) Systems which have 3 consecutive annual samples with no detection of a contaminant may apply to the State for a waiver as specified in paragraph (h)(6) of this section.

(v) If monitoring results in detection of one or more of certain related contaminants (aldicarb, aldicarb sulfone, aldicarb sulfoxide and heptachlor, heptachlor epoxide), then subsequent monitoring shall analyze for all related contaminants.

(8) Systems which violate the requirements of § 141.61(c) as determined by paragraph (h)(12) of this section must monitor quarterly. After a maximum of four quarterly samples show the system is in compliance and the State determines the system is reliably and consistently below the MCL as specified in paragraph (h)(11) of this section, the system shall monitor at the frequency specified in paragraph (h)(7)(iii) of this section.

(9) The State may require a confirmation sample for positive or negative results. If a confirmation sample is required by the State, the result must be averaged with the first sampling result and the average used for the compliance determination as specified by paragraph (h)(11) of this section. States have discretion to delete results of obvious sampling errors from this calculation.

(10) The State may reduce the total number of samples a system must analyze by allowing the use of

compositing. Composite samples from a maximum of five sampling points are allowed. Compositing of samples must be done in the laboratory and analyzed within 14 days of sample collections.

(i) If the concentration in the composite sample detects one or more contaminants listed in § 141.61(c), then a follow-up sample must be taken and analyzed within 14 days from each sampling point included in the composite.

(ii) If duplicates of the original sample taken from each sampling point used in the composite are available, the system may use these duplicates instead of resampling. The duplicate must be analyzed and the results reported to the State within 14 days of collection.

(iii) If the population served by the system is >3,300 persons, then compositing may only be permitted by the State at sampling points within a single system. In systems serving <3,300 persons, the State may permit compositing among different systems provided the 5-sample limit is maintained.

(11) Compliance with § 141.61(c) shall be determined based on the analytical results obtained at each sampling point.

(i) For systems which are conducting monitoring at a frequency greater than annual, compliance is determined by a running annual average of all samples taken at each sampling point. If the annual average of any sampling point is greater than the MCL, then the system is out of compliance. If the initial sample or a subsequent sample would cause the annual average to be exceeded, then the system is out of compliance immediately. Any samples below the detection limit shall be calculated as zero for purposes of determining the annual average.

(ii) If monitoring is conducted annually, or less frequently, the system is out of compliance if the level of a contaminant at any sampling point is greater than the MCL. If a confirmation sample is required by the State, the determination of compliance will be based on the average of two samples.

(iii) If a public water system has a distribution system separable from other parts of the distribution system with no interconnections, the State may allow the system to give public notice to only that portion of the system which is out of compliance.

(12) Analysis for the contaminants listed in § 141.61(c) shall be conducted using the following EPA methods or their equivalent as approved by EPA. These methods are contained in "Methods for the Determination of Organic Compounds in Drinking Water," ORD Publications, CERL EPA/600/4-88/

039, December 1988. These documents are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. The toll-free number is 1-800-338-4700.

(i) Method 504, "1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-chloropropane (DBCP) in Water by Microextraction and Gas Chromatography." Method 504 can be used to measure dibromochloropropane (DBCP) and ethylene dibromide (EDB).

(ii) Method 505, "Analysis of Organohalide Pesticides and Commercial Polychlorinated Biphenyl Products (Aroclors) in Water by Microextraction and Gas Chromatography." Method 505 can be used to measure alachlor, atrazine, chlordane, heptachlor, heptachlor epoxide, lindane, methoxychlor, and toxaphene. Method 505 can be used as a screen for PCBs.

(iii) Method 507, "Determination of Nitrogen- and Phosphorus-Containing Pesticides in Ground Water by Gas Chromatography with a Nitrogen-Phosphorus Detector." Method 507 can be used to measure alachlor and atrazine.

(iv) Method 508, "Determination of Chlorinated Pesticides in Water by Gas Chromatography with an Electron Capture Detector." Method 508 can be used to measure chlordane, heptachlor, heptachlor epoxide, lindane and methoxychlor. Method 508 can be used as a screen for PCBs.

(v) Method 508A, "Screening for Polychlorinated Biphenyls by Perchlorination and Gas Chromatography." Method 508A is used to quantitate PCBs as decachlorobiphenyl if detected in Methods 506 or 508.

(vi) Method 515.1, "Determination of Chlorinated Acids in Water by Gas Chromatography with an Electron Capture Detector." Method 515.1 can be used to measure 2,4-D, 2,4,5-TP (Silvex) and pentachlorophenol.

(vii) Method 525, "Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry." Method 525 can be used to measure alachlor, atrazine, chlordane, heptachlor, heptachlor epoxide, lindane, methoxychlor, and pentachlorophenol.

(viii) Method 531.1, "Measurement of N-Methyl Carbamoyloximes and N-Methyl Carbamates in Water by Direct Aqueous Injection HPLC with Post-Column Derivatization." Method 531.1 can be used to measure aldicarb, aldicarb sulfoxide, aldicarb sulfone, and carbofuran.

(13) Analysis for PCBs shall be conducted as follows:

(i) Each system which monitors for PCBs shall analyze each sample using either Method 505 or Method 508 (see paragraph (h)(13) of this section).

(ii) If PCBs (as one of seven Aroclors) are detected (as designated in this paragraph) in any sample analyzed using Methods 505 or 508, the system shall reanalyze the sample using Method 508A to quantitate PCBs (as decachlorobiphenyl).

Aroclor	Detection limit (mg/l)
1016	0.00008
1221	0.02
1232	0.0005
1242	0.0003
1248	0.0001
1254	0.0001
1260	0.0002

(iii) Compliance with the PCB MCL shall be determined based upon the quantitative results of analyses using Method 508A.

(14) If monitoring data collected after January 1, 1990, are generally consistent with the requirements of § 141.24(h), then the State may allow systems to use that data to satisfy the monitoring requirement for the initial compliance period beginning January 1, 1993.

(15) The State may increase the required monitoring frequency, where necessary, to detect variations within the system (e.g., fluctuations in concentration due to seasonal use, changes in water source).

(16) The State has the authority to determine compliance or initiate enforcement action based upon analytical results and other information compiled by their sanctioned representatives and agencies.

(17) Each public water system shall monitor at the time designated by the State within each compliance period.

(18) Detection as used in this paragraph shall be defined as greater than or equal to the following concentrations for each contaminant.

Contaminant	Detection limit (mg/l)
Alechlor	0.0002
Aldicarb	0.006
Aldicarb sulfate	0.006
Aldicarb sulfonate	0.006
Atrazine	0.001
Carbofuran	0.006
Chlordane	0.002
Dibromochloropropane (DBCP)	0.0002
2,4-D	0.001
Ethylene dibromide (EDB)	0.0001
Heptachlor	0.0004
Heptachlor epoxide	0.0002

Contaminant	Detection limit (mg/l)
Endane	0.0002
Methoxychlor	0.001
Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl)	0.001
Pentachlorophenol	0.0004
Toxaphene	0.01
2,4,5-TP (Silvex)	0.002

6. In § 141.32, paragraph (a)(1)(iii)(B) is revised, paragraphs (e) (13), (14), (16), (25), (26), (27), and (46) are reserved, and paragraphs (e) (15), (17) through (24), (28) through (45), and (47) through (52) are added to read as follows:

§ 141.32 Public notification.

(a) . . .
(1) . . .
(iii) . . .

(B) Violation of the MCL for nitrate or nitrite as defined in § 141.62 and determined according to § 141.23(i)(3).

(e) . . .

(13)-(14) [Reserved]

(15) **Asbestos.** The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that asbestos fibers greater than 10 micrometers in length are a health concern at certain levels of exposure. Asbestos is a naturally occurring mineral. Most asbestos fibers in drinking water are less than 10 micrometers in length and occur in drinking water from natural sources and from corroded asbestos-cement pipes in the distribution system. The major uses of asbestos were in the production of cements, floor tiles, paper products, paint, and caulking; in transportation-related applications; and in the production of textiles and plastics. Asbestos was once a popular insulating and fire retardant material. Inhalation studies have shown that various forms of asbestos have produced lung tumors in laboratory animals. The available information on the risk of developing gastrointestinal tract cancer associated with the ingestion of asbestos from drinking water is limited. Ingestion of intermediate-range chrysotile asbestos fibers greater than 10 micrometers in length is associated with causing benign tumors in male rats. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for asbestos at 7 million long fibers per liter to reduce the potential risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets the EPA standard is associated with little to none of this risk.

and should be considered safe with respect to asbestos.

(16) [Reserved]

(17) **Cadmium.** The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that cadmium is a health concern at certain levels of exposure. Food and the smoking of tobacco are common sources of general exposure. This inorganic metal is a contaminant in the metals used to galvanize pipe. It generally gets into water by corrosion of galvanized pipes or by improper waste disposal. This chemical has been shown to damage the kidney in animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the kidney. EPA has set the drinking water standard for cadmium at 0.005 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to cadmium.

(18) **Chromium.** The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that chromium is a health concern at certain levels of exposure. This inorganic metal occurs naturally in the ground and is often used in the electroplating of metals. It generally gets into water from runoff from old mining operations and improper waste disposal from plating operations. This chemical has been shown to damage the kidney, nervous system, and the circulatory system of laboratory animals such as rats and mice when the animals are exposed at high levels. Some humans who were exposed to high levels of this chemical suffered liver and kidney damage, dermatitis and respiratory problems. EPA has set the drinking water standard for chromium at 0.1 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to chromium.

(19) **Mercury.** The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that mercury is a health concern at certain levels of exposure. This inorganic metal is used in electric equipment and some water pumps. It usually gets into water as a result of improper waste disposal. This chemical has been shown to damage the kidney in laboratory animals such as rats when

the animals are exposed at high levels over their lifetimes. EPA has set the drinking water standard for mercury at 0.002 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to mercury.

(20) *Nitrate*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that nitrate poses an acute health concern at certain levels of exposure. Nitrate is used in fertilizer and is found in sewage and wastes from human and/or farm animals and generally gets into drinking water from those activities. Excessive levels of nitrate in drinking water have caused serious illness and sometimes death in infants under six months of age. The serious illness in infants is caused because nitrate is converted to nitrite in the body. Nitrite interferes with the oxygen carrying capacity of the child's blood. This is an acute disease in that symptoms can develop rapidly in infants. In most cases, health deteriorates over a period of days. Symptoms include shortness of breath and blueness of the skin. Clearly, expert medical advice should be sought immediately if these symptoms occur. The purpose of this notice is to encourage parents and other responsible parties to provide infants with an alternate source of drinking water. Local and State health authorities are the best source for information concerning alternate sources of drinking water for infants. EPA has set the drinking water standard at 10 parts per million (ppm) for nitrate to protect against the risk of these adverse effects. EPA has also set a drinking water standard for nitrite at 1 ppm. To allow for the fact that the toxicity of nitrate and nitrite are additive, EPA has also established a standard for the sum of nitrate and nitrite at 10 ppm. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to nitrate.

(21) *Nitrite*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that nitrite poses an acute health concern at certain levels of exposure. This inorganic chemical is used in fertilizers and is found in sewage and wastes from humans and/or farm animals and generally gets into drinking water as a result of those activities. While excessive levels of nitrite in drinking water have not been observed, other sources of nitrite have caused serious illness and sometimes

death in infants under six months of age. The serious illness in infants is caused because nitrite interferes with the oxygen carrying capacity of the child's blood. This is an acute disease in that symptoms can develop rapidly. However, in most cases, health deteriorates over a period of days. Symptoms include shortness of breath and blueness of the skin. Clearly, expert medical advice should be sought immediately if these symptoms occur. The purpose of this notice is to encourage parents and other responsible parties to provide infants with an alternate source of drinking water. Local and State health authorities are the best source for information concerning alternate sources of drinking water for infants. EPA has set the drinking water standard at 1 part per million (ppm) for nitrite to protect against the risk of these adverse effects. EPA has also set a drinking water standard for nitrate (converted to nitrite in humans) at 10 ppm and for the sum of nitrate and nitrite at 10 ppm. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to nitrite.

(22) *Selenium*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that selenium is a health concern at certain high levels of exposure. Selenium is also an essential nutrient at low levels of exposure. This inorganic chemical is found naturally in food and soils and is used in electronics, photocopy operations, the manufacture of glass, chemicals, drugs, and as a fungicide and a feed additive. In humans, exposure to high levels of selenium over a long period of time has resulted in a number of adverse health effects, including a loss of feeling and control in the arms and legs. EPA has set the drinking water standard for selenium at 0.05 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to selenium.

(23) *Acrylamide*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that acrylamide is a health concern at certain levels of exposure. Polymers made from acrylamide are sometimes used to treat water supplies to remove particulate contaminants. Acrylamide has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in

laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. Sufficiently large doses of acrylamide are known to cause neurological injury. EPA has set the drinking water standard for acrylamide using a treatment technique to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. This treatment technique limits the amount of acrylamide in the polymer and the amount of the polymer which may be added to drinking water to remove particulates. Drinking water systems which comply with this treatment technique have little to no risk and are considered safe with respect to acrylamide.

(24) *Alachlor*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that alachlor is a health concern at certain levels of exposure. This organic chemical is a widely used pesticide. When soil and climatic conditions are favorable, alachlor may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for alachlor at 0.002 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets this standard is associated with little to none of this risk and is considered safe with respect to alachlor.

(25) - (27) [Reserved]

(28) *Atrazine*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that atrazine is a health concern at certain levels of exposure. This organic chemical is a herbicide. When soil and climatic conditions are favorable, atrazine may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to affect offspring of rats and the heart of dogs. EPA has set the drinking water standard for atrazine at 0.003 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to atrazine.

(29) *Carbofuran*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that carbofuran is a health concern at certain levels of exposure. This organic chemical is a pesticide. When soil and climatic conditions are favorable, carbofuran may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to damage the nervous and reproductive systems of laboratory animals such as rats and mice exposed at high levels over their lifetimes. Some humans who were exposed to relatively large amounts of this chemical during their working careers also suffered damage to the nervous system. Effects on the nervous system are generally rapidly reversible. EPA has set the drinking water standard for carbofuran at 0.04 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to carbofuran.

(30) *Chlordane*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that chlordane is a health concern at certain levels of exposure. This organic chemical is a pesticide used control termites. Chlordane is not very mobile in soils. It usually gets into drinking water after application near water supply intakes or wells. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for chlordane at 0.002 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to chlordane.

(31) *Dibromochloropropane (DBCP)*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that DBCP is a health concern at certain levels of exposure. This organic chemical was once a popular pesticide. When soil and climatic conditions are favorable, dibromochloropropane may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such

as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for DBCP at 0.0002 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to DBCP.

(32) *o-Dichlorobenzene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that o-dichlorobenzene is a health concern at certain levels of exposure. This organic chemical is used as a solvent in the production of pesticides and dyes. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, kidney and the blood cells of laboratory animals such as rats and mice exposed to high levels during their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the liver, nervous system, and circulatory system. EPA has set the drinking water standard for o-dichlorobenzene at 0.6 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to o-dichlorobenzene.

(33) *cis-1,2-Dichloroethylene*. The United States Environmental Protection Agency (EPA) establishes drinking water standards and has determined that cis-1,2-dichloroethylene is a health concern at certain levels of exposure. This organic chemical is used as a solvent and intermediate in chemical production. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, nervous system, and circulatory system of laboratory animals such as rats and mice when exposed at high levels over their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set the drinking water standard for cis-1,2-dichloroethylene at 0.07 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to cis-1,2-dichloroethylene.

(34) *trans-1,2-Dichloroethylene*. The United States Environmental Protection Agency (EPA) establishes drinking water standards and has determined that trans-1,2-dichloroethylene is a health concern at certain levels of exposure. This organic chemical is used as a solvent and intermediate in chemical production. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, nervous system, and the circulatory system of laboratory animals such as rats and mice when exposed at high levels over their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set drinking water standard for trans-1,2-dichloroethylene at 0.1 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to trans-1,2-dichloroethylene.

(35) *1,2-Dichloropropane*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that 1,2-dichloropropane is a health concern at certain levels of exposure. This organic chemical is used as a solvent and pesticide. When soil and climatic conditions are favorable, 1,2-dichloropropane may get into drinking water by runoff into surface water or by leaching into ground water. It may also get into drinking water through improper waste disposal. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for 1,2-dichloropropane at 0.005 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to 1,2-dichloropropane.

(36) *2,4-D*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that 2,4-D is a health concern at certain levels of exposure. This organic chemical is used as a herbicide and to control algae in reservoirs. When soil and climatic conditions are favorable, 2,4-D may get into drinking water by runoff into surface water or by leaching into ground

water. This chemical has been shown to damage the liver and kidney of laboratory animals such as rats exposed at high levels during their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set the drinking water standard for 2,4-D at 0.07 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to 2,4-D.

(37) *Epichlorohydrin*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that epichlorohydrin is a health concern at certain levels of exposure. Polymers made from epichlorohydrin are sometimes used in the treatment of water supplies as a flocculent to remove particulates. Epichlorohydrin generally gets into drinking water by improper use of these polymers. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for epichlorohydrin using a treatment technique to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. This treatment technique limits the amount of epichlorohydrin in the polymer and the amount of the polymer which may be added to drinking water as a flocculent to remove particulates. Drinking water systems which comply with this treatment technique have little to no risk and are considered safe with respect to epichlorohydrin.

(38) *Ethylbenzene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined ethylbenzene is a health concern at certain levels of exposure. This organic chemical is a major component of gasoline. It generally gets into water by improper waste disposal or leaking gasoline tanks. This chemical has been shown to damage the kidney, liver, and nervous system of laboratory animals such as rats exposed to high levels during their lifetimes. EPA has set the drinking water standard for ethylbenzene at 0.7 part per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk

and is considered safe with respect to ethylbenzene.

(39) *Ethylene dibromide (EDB)*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that EDB is a health concern at certain levels of exposure. This organic chemical was once a popular pesticide. When soil and climatic conditions are favorable, EDB may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for EDB at 0.00005 part per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets this standard is associated with little to none of this risk and is considered safe with respect to EDB.

(40) *Heptachlor*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that heptachlor is a health concern at certain levels of exposure. This organic chemical was once a popular pesticide. When soil and climatic conditions are favorable, heptachlor may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for heptachlor at 0.0004 part per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets this standard is associated with little to none of this risk and is considered safe with respect to heptachlor.

(41) *Heptachlor epoxide*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that heptachlor epoxide is a health concern at certain levels of exposure. This organic chemical was once a popular pesticide. When soil and climatic conditions are favorable, heptachlor epoxide may get into drinking water by runoff into surface water or by leaching into ground water.

This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standards for heptachlor epoxide at 0.0002 part per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets this standard is associated with little to none of this risk and is considered safe with respect to heptachlor epoxide.

(42) *Lindane*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that lindane is a health concern at certain levels of exposure. This organic chemical is used as a pesticide. When soil and climatic conditions are favorable, lindane may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to damage the liver, kidney, nervous system, and immune system of laboratory animals such as rats, mice and dogs exposed at high levels during their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system and circulatory system. EPA has established the drinking water standard for lindane at 0.0002 part per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to lindane.

(43) *Methoxychlor*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that methoxychlor is a health concern at certain levels of exposure. This organic chemical is used as a pesticide. When soil and climatic conditions are favorable, methoxychlor may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to damage the liver, kidney, nervous system, and reproductive system of laboratory animals such as rats exposed at high levels during their lifetimes. It has also been shown to produce growth retardation in rats. EPA has set the drinking water standard for methoxychlor at 0.04 part per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk

and is considered safe with respect to methoxychlor.

(44) *Monochlorobenzene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that monochlorobenzene is a health concern at certain levels of exposure. This organic chemical is used as a solvent. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, kidney and nervous system of laboratory animals such as rats and mice exposed to high levels during their lifetimes. EPA has set the drinking water standard for monochlorobenzene at 0.1 part per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to monochlorobenzene.

(45) *Polychlorinated biphenyls (PCBs)*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that polychlorinated biphenyls (PCBs) are a health concern at certain levels of exposure. These organic chemicals were once widely used in electrical transformers and other industrial equipment. They generally get into drinking water by improper waste disposal or leaking electrical industrial equipment. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for PCBs at 0.0005 part per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets this standard is associated with little to none of this risk and is considered safe with respect to PCBs.

(46) [Reserved]

(47) *Styrene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that styrene is a health concern at certain levels of exposure. This organic chemical is commonly used to make plastics and is sometimes a component of resins used for drinking water treatment. Styrene may get into drinking water from improper waste disposal. This chemical has been shown to damage the liver and nervous system in laboratory animals when exposed at high levels during their lifetimes. EPA has set the drinking water standard for styrene at 0.1 part per million (ppm) to protect against the risk of these adverse

health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to styrene.

(48) *Tetrachloroethylene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that tetrachloroethylene is a health concern at certain levels of exposure. This organic chemical has been a popular solvent, particularly for dry cleaning. It generally gets into drinking water by improper waste disposal. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for tetrachloroethylene at 0.005 part per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets this standard is associated with little to none of this risk and is considered safe with respect to tetrachloroethylene.

(49) *Toluene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that toluene is a health concern at certain levels of exposure. This organic chemical is used as a solvent and in the manufacture of gasoline for airplanes. It generally gets into water by improper waste disposal or leaking underground storage tanks. This chemical has been shown to damage the kidney, nervous system, and circulatory system of laboratory animals such as rats and mice exposed to high levels during their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the liver, kidney and nervous system. EPA has set the drinking water standard for toluene at 1 part per million (ppm) to protect against the risk of adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to toluene.

(50) *Toxaphene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that toxaphene is a health concern at certain levels of exposure. This organic chemical was once a pesticide widely used on cotton, corn, soybeans, pineapples and other crops. When soil and climatic conditions are favorable, toxaphene may get into drinking water by runoff into surface water or by leaching into ground water.

This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for toxaphene at 0.003 part per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets this standard is associated with little to none of this risk and is considered safe with respect to toxaphene.

(51) *2,4,5-TP*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that 2,4,5-TP is a health concern at certain levels of exposure. This organic chemical is used as a herbicide. When soil and climatic conditions are favorable, 2,4,5-TP may get into drinking water by runoff into surface water or by leaching into ground water. This chemical has been shown to damage the liver and kidney of laboratory animals such as rats and dogs exposed to high levels during their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the nervous system. EPA has set the drinking water standard for 2,4,5-TP at 0.05 part per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and is considered safe with respect to 2,4,5-TP.

(52) *Xylenes*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that xylene is a health concern at certain levels of exposure. This organic chemical is used in the manufacture of gasoline for airplanes and as a solvent for pesticides, and as a cleaner and degreaser of metals. It usually gets into water by improper waste disposal. This chemical has been shown to damage the liver, kidney and nervous system of laboratory animals such as rats and dogs exposed to high levels during their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set the drinking water standard for xylene at 10 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk

and is considered safe with respect to xylene.

7. In § 141.40 the section heading is revised and a new paragraph (n) is added to read as follows:

§ 141.40 Special monitoring for inorganic and organic chemicals.

(n) Monitoring of the contaminants listed in § 141.40(n) (11) and (12) shall be conducted as follows:

(1) Each community and non-transient, non-community water system shall take four consecutive quarterly samples at each sampling point for each contaminant listed in paragraph (n)(11) of this section and report the results to the State. Monitoring must be completed by December 31, 1995.

(2) Each community and non-transient non-community water system shall take one sample at each sampling point for each contaminant listed in paragraph (n)(12) of this section and report the results to the State. Monitoring must be completed by December 31, 1995.

(3) Each community and non-transient non-community water system may apply to the State for a waiver from the requirements of paragraph (n) (1) and (2) of this section.

(4) The State may grant a waiver for the requirement of paragraph (n)(1) of this section based on the criteria specified in § 141.24(h)(6). The State may grant a waiver from the requirement of paragraph (n)(2) of this section if previous analytical results indicate contamination would not occur, provided this data was collected after January 1, 1990.

(5) Groundwater systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(6) Surface water systems shall take a minimum of one sample at points in the distribution system that are representative of each source or at each entry point to the distribution system after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

Note: For purposes of this paragraph, surface water systems include systems with a combination of surface and ground sources.

(7) If the system draws water from more than one source and the sources

are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water representative of all sources is being used).

(8) The State may require a confirmation sample for positive or negative results.

(9) The State may reduce the total number of samples a system must analyze by allowing the use of compositing. Composite samples from a maximum of five sampling points are allowed. Compositing of samples must be done in the laboratory and the composite sample must be analyzed within 14 days of collection. If the population served by the system is > 3,300 persons, then compositing may only be permitted by the State at sampling points within a single system. In systems serving ≤ 3,300 persons, the State may permit compositing among different systems provided the 5-sample limit is maintained.

(10) Instead of performing the monitoring required by this section, a community water system or non-transient non-community water system serving fewer than 150 service connections may send a letter to the State stating that the system is available for sampling. This letter must be sent to the State by January 1, 1994. The system shall not send such samples to the State, unless requested to do so by the State.

(11) List of Unregulated Organic Contaminants:

Organic contaminants	EPA analytical method
Aldrin.....	505, 508, 525
Benzo(a)pyrene.....	525, 550, 550.1
Butachlor.....	507, 525
Carbaryl.....	531.1
Delapone.....	515.1
Di(2-ethylhexyl)adipate.....	508, 525
Di(2-ethylhexyl)phthalates.....	508, 525
Dicamba.....	516.1
Dieldrin.....	505, 508, 525
Dinoseb.....	515.1
Diquat.....	549
Endosulf.....	548
Glyphosate.....	547
Hexachlorobenzene.....	505, 508, 525
Hexachlorocyclopentadiene.....	505, 525
3-Hydroxycarbofuran.....	531.1
Methomyl.....	531.1
Metolachlor.....	507, 525
Metribuzin.....	507, 508, 525
Oxamyl (Vydate).....	531.1
Picloram.....	515.1
Propanil.....	507, 525
Simazine.....	505, 507, 525
2,3,7,8-TCDD (Dioxin).....	513

(12) List of Unregulated Inorganic Contaminants:

Contaminant	EPA analytical method
(i) Antimony.....	Graphite Furnace Atomic Absorption; Inductively Coupled Plasma.
(ii) Beryllium.....	Graphite Furnace Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma; Spectrophotometric.
(iii) Nickel.....	Atomic Absorption; Inductively Coupled Plasma; Graphite Furnace Atomic Absorption.
(iv) Sulfate.....	Colorimetric.
(v) Thallium.....	Graphite Furnace Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma.
(vi) Cyanide.....	Spectrophotometric.

8. Section 141.50 is amended in the table by adding paragraphs (a)(6) through (a)(14), reserving (a)(15), adding (a)(16) through (a)(18), reserving (b)(4) through (b)(6), and adding (b)(7) through (20) to read as follows:

§ 141.50 Maximum contaminant level goals for organic chemicals.

- (a) * * *
- (6) Acrylamide
 - (7) Alachlor
 - (8) Chlordane
 - (9) Dibromochloropropane
 - (10) 1,2-Dichloropropane
 - (11) Epichlorohydrin
 - (12) Ethylene dibromide
 - (13) Heptachlor
 - (14) Heptachlor epoxide
 - (15) [Reserved]
 - (16) Polychlorinated biphenyls (PCBs)
 - (17) Tetrachloroethylene
 - (18) Toxaphene
- (b) * * *

Contaminant	MCLG (mg/l)
(4)-(6) [Reserved]	
(7) Atrazine.....	0.003
(8) Carbofuran.....	0.04
(9) o-Dichlorobenzene.....	0.6
(10) cis-1,2-Dichloroethylene.....	0.07
(11) trans-1,2-Dichloroethylene.....	0.1
(12) 2,4-D.....	0.07
(13) Ethylbenzene.....	0.7
(14) Lindane.....	0.0002
(15) Methoxychlor.....	0.04
(16) Monochlorobenzene.....	0.1
(17) Styrene.....	0.1
(18) Toluene.....	1
(19) 2,4,5-TP.....	0.05
(20) Xylenes (total).....	10

9. Section 141.51 is amended in the table by adding (b)(2), reserving (b)(3), adding (b) (4) through (9) and revising the heading for the second column to read as follows:

§ 141.51 Maximum contaminant level goals for inorganic contaminants.

(b) . . .

Contaminant	MCLG (mg/l)
(2) Asbestos	7 Million fibers/liter (longer than 10 μ m).
(3) (Reserved)	
(4) Cadmium	0.005
(5) Chromium	0.1
(6) Mercury	0.002
(7) Nitrate	10 (as Nitrogen).
(8) Nitrite	1 (as Nitrogen).
(9) Total Nitrate + Nitrite	10 (as Nitrogen).
(10) Selenium	0.05

10. Section 141.60 is revised to read as follows:

§ 141.60 Effective dates.

(a) The effective dates for § 141.61 are as follows:

(1) The effective date for paragraphs (a)(1) through (a)(8) of § 141.61 is January 9, 1989.

(2) The effective date for paragraphs (a)(9) through (a)(18) and (c)(1) through (c)(18) of § 141.61 is July 30, 1992.

(b) The effective dates for § 141.62 are as follows:

(1) The effective date of paragraph (b)(1) of § 141.62 is October 2, 1987.

(2) The effective date for paragraphs (b)(2) and (b)(4) through (b)(10) of § 141.62 is July 30, 1992.

11. Section 141.61 is revised to read as follows:

§ 141.61 Maximum contaminant levels for organic contaminants.

(a) The following maximum contaminant levels for organic contaminants apply to community and non-transient, non-community water systems.

CAS No.	Contaminant	MCL (mg/l)
(1) 75-01-4	Vinyl chloride	0.002
(2) 71-43-2	Benzene	0.005
(3) 58-23-5	Carbon tetrachloride	0.005
(4) 107-06-2	1,2-Dichloroethane	0.005
(5) 79-01-8	Trichloroethylene	0.005
(6) 106-46-7	para-Dichlorobenzene	0.075
(7) 75-35-4	1,1-Dichloroethylene	0.007
(8) 71-55-8	1,1,1-Trichloroethane	0.2
(9) 156-59-2	cis-1,2-Dichloroethylene	0.07
(10) 78-87-5	1,2-Dichloropropane	0.005
(11) 100-61-4	Ethylbenzene	0.7
(12) 106-80-7	Monochlorobenzene	0.1
(13) 95-50-1	o-Dichlorobenzene	0.6
(14) 100-42-5	Styrene	0.1
(15) 127-18-4	Tetrachloroethylene	0.005
(16) 106-88-3	Toluene	1
(17) 156-60-5	trans-1,2-Dichloroethylene	0.1
(18) 1330-20-7	Xylenes (total)	10

(b) The Administrator, pursuant to section 1412 of the Act, hereby identifies as indicated in the Table below either granular activated carbon (GAC),

packed tower aeration (PTA), or both as the best technology treatment technique, or other means available for achieving compliance with the

maximum contaminant level for organic contaminants identified in paragraphs (a) and (c) of this section:

BAT FOR ORGANIC CONTAMINANTS LISTED IN SECTION 141.61 (a) AND (c)

CAS No.	Chemical	GAC	PTA
15972-60-8	Alachlor	X	
116-06-3	Aldicarb	X	
1646-86-4	Aldicarb sulfone	X	
1646-87-3	Aldicarb sulfide	X	
1912-24-9	Atrazine	X	
71-43-2	Benzene	X	X
1563-86-2	Carbaryl	X	
56-23-5	Carbon tetrachloride	X	X
57-74-9	Chlordane	X	
94-75-7	2,4-D	X	
96-12-8	Dibromochloropropane (DBCP)	X	X
95-50-1	o-Dichlorobenzene	X	X
107-06-2	1,2-Dichloroethane	X	X
156-59-2	cis-1,2-Dichloroethylene	X	X
156-60-5	trans-1,2-Dichloroethylene	X	X
75-35-4	1,1-Dichloroethylene	X	X
78-87-5	1,2-Dichloropropane	X	X
106-83-4	Ethylene Dibromide (EDB)	X	X
100-41-4	Ethylbenzene	X	X
76-44-8	Heptachlor	X	
1024-57-3	Heptachlor epoxide	X	
58-89-9	Lindane	X	
72-43-5	Methoxychlor	X	
106-90-7	Monochlorobenzene	X	X
106-46-7	para-Dichlorobenzene	X	X
1336-36-3	Polychlorinated biphenyls (PCB)	X	
87-86-5	Pentachlorophenol	X	

BAT FOR ORGANIC CONTAMINANTS LISTED IN SECTION 141.61 (a) AND (c)—Continued

CAS No.	Chemical	GAC	PTA
100-42-6	Styrene	X	X
93-72-1	2,4,5-TP (Silvex)	X	
127-18-4	Tetrachloroethylene	X	X
71-55-6	1,1,1-Trichloroethane	X	X
78-01-6	Trichloroethylene	X	X
106-88-3	Toluene	X	
8001-35-2	Toxaphene	X	X
75-01-4	Vinyl chloride		X
1330-20-7	Xylene	X	X

(c) The following maximum contaminant levels for organic

contaminants apply to community water systems and non-transient, non-community water systems.

CAS No.	Contaminant	MCL (mg/l)
(1) 15072-80-8	Alachlor	0.002
(2)	[Reserved]	
(3)	[Reserved]	
(4)	[Reserved]	
(5) 1912-24-9	Atrazine	0.003
(6) 1563-06-2	Carbofuran	0.04
(7) 57-74-9	Chlordane	0.002
(8) 96-12-8	Dibromochloropropane	0.0002
(9) 94-75-7	2,4-D	0.07
(10) 106-93-4	Ethylene dibromide	0.00006
(11) 76-44-8	Heptachlor	0.0004
(12) 1024-57-3	Heptachlor epoxide	0.0002
(13) 58-89-9	Lindane	0.0002
(14) 72-43-5	Methoxychlor	0.04
(15) 1336-36-3	Polychlorinated biphenyls	0.0005
(16)	[Reserved]	
(17) 8001-35-2	Toxaphene	0.003
(18) 93-72-1	2,4,5-TP	0.05

12. Section 141.62 is revised to read as follows:

§ 141.62 Maximum contaminant levels for inorganic contaminants.

(a) [Reserved]

(b) The maximum contaminant levels for inorganic contaminants specified in paragraphs (b)(2) through (6) and (b)(10) of this section apply to community water systems and non-transient, non-community water systems. The Maximum Contaminant Level specified in paragraph (b)(1) of this section only applies to community water systems. The Maximum Contaminant Levels specified in paragraphs (b)(7), (b)(8), and (b)(9) of this section apply to community, non-transient non-community, and transient non-community water systems.

Contaminant	MCL (mg/l)
(1) Fluoride	4
(2) Asbestos	7 Million Fibers/liter (longer than 10 µm)
(3) [Reserved]	
(4) Cadmium	0.005
(5) Chromium	0.1
(6) Mercury	0.002
(7) Nitrate	10 (as Nitrogen)
(8) Nitrite	1 (as Nitrogen)

Contaminant	MCL (mg/l)
(9) Total Nitrate and Nitrite	10 (as Nitrogen)
(10) Selenium	0.05

(c) The Administrator, pursuant to section 1412 of the Act, hereby identifies the following as the best technology treatment technique, or other means available for achieving compliance with the maximum contaminant level for inorganic contaminants identified in paragraph (b) of this section, except fluoride:

BAT FOR INORGANIC CONTAMINANTS LISTED IN § 141.62(b)

Chemical name	BAT(s)
Asbestos	2,3,8
Barium	5,6,7,9
Cadmium	2,5,6,7
Chromium	2,5,6,7
Mercury	2,1,4,6,7,1
Nitrate	5,7,9
Nitrite	5,7
Selenium	1,2,6,7,9

¹ BAT only if influent Hg concentrations <10 µg/l.

² BAT for Chromium III only.

³ BAT for Selenium IV only.

Key to BATs in Table:

1 = Activated Alumina

- 2 = Coagulation/Filtration
- 3 = Direct and Diatomite Filtration
- 4 = Granular Activated Carbon
- 5 = Ion Exchange
- 6 = Lime Softening
- 7 = Reverse Osmosis
- 8 = Corrosion Control
- 9 = Electrodialysis

13. A new subpart K is added to part 141 to read as follows:

Subpart K—Treatment Techniques

Sec.

141.110 General requirements.

141.111 Treatment techniques for acrylamide and epichlorohydrin.

Subpart K—Treatment Techniques

§ 141.110 General requirements.

The requirements of subpart K of this part constitute national primary drinking water regulations. These regulations establish treatment techniques in lieu of maximum contaminant levels for specified contaminants.

§ 141.111 Treatment techniques for acrylamide and epichlorohydrin.

Each public water system must certify annually in writing to the State (using third party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking

water systems, the combination (or product) of dose and monomer level does not exceed the levels specified as follows:

Acrylamide=0.05% dosed at 1 ppm (or equivalent)

Epichlorohydrin=0.01% dosed at 20 ppm (or equivalent)

Certifications can rely on manufacturers or third parties, as approved by the State.

PART 142—NATIONAL PRIMARY DRINKING WATER REGULATIONS IMPLEMENTATION

1. The authority citation for part 142 continues to read as follows:

Authority: 42 U.S.C. 300g, 300g-1, 300g-2, 300g-3, 300g-4, 300g-5, 300g-6, 300j-4 and 300j-9.

2. Section 142.14 is amended by revising paragraph (a)(6), paragraph (c), the introductory text to paragraph (d), and paragraph (f); and by adding paragraphs (d)(4) through (d)(7) to read as follows:

§ 142.14 Records kept by States.

(a) * * *

(6) Records of analysis for other than microbiological contaminants (including total coliform, fecal coliform, and heterotrophic plate count), residual disinfectant concentration, other parameters necessary to determine disinfection effectiveness (including temperature and pH measurements), and turbidity shall be retained for not less than 12 years and shall include at least the following information:

(c) Each State which has primary enforcement responsibility shall maintain current inventory information for every public water system in the State and shall retain inventory records of public water systems for not less than 12 years.

(d) Each State which has primary enforcement responsibility shall retain, for not less than 12 years, files which shall include for each such public water system in the State:

(4) A record of the most recent vulnerability determination, including the monitoring results and other data supporting the determination, the State's findings based on the supporting data and any additional bases for such determination; except that it shall be kept in perpetuity or until a more current vulnerability determination has been issued.

(5) A record of all current monitoring requirements and the most recent monitoring frequency decision

pertaining to each contaminant, including the monitoring results and other data supporting the decision, the State's findings based on the supporting data and any additional bases for such decision; except that the record shall be kept in perpetuity or until a more recent monitoring frequency decision has been issued.

(6) A record of the most recent asbestos repeat monitoring determination, including the monitoring results and other data supporting the determination, the State's findings based on the supporting data and any additional bases for the determination, and the repeat monitoring frequency; except that these records shall be maintained in perpetuity or until a more current repeat monitoring determination has been issued.

(7) Records of annual certifications received from systems pursuant to part 141, subpart K demonstrating the system's compliance with the treatment techniques for acrylamide and/or epichlorohydrin in § 14.111.

(f) Records required to be kept under this section shall be available to the Regional Administrator upon request. The records required to be kept under this section shall be maintained and made available for public inspection by the State, or, the State at its option may require suppliers of water to make available for public inspection those records maintained in accordance with § 141.33

3. In § 142.15 is amended by adding new paragraph (c)(3) to read as follows:

§ 142.15 Reports by States.

(c) * * *

(3) The results of monitoring for unregulated contaminants shall be reported quarterly.

4. § 142.16 is amended by reserving paragraph (d) and by adding a new paragraph (e) to read as follows:

§ 142.16 Special primary requirements.

(d) [Reserved]

(e) An application for approval of a State program revision which adopts the requirements specified in §§ 141.23, 141.24, 141.32, 141.40, 141.61, 141.62, and 141.11 must contain the following (in addition to the general primary requirements enumerated elsewhere in this part, including the requirement that state regulations be at least as stringent as the federal requirements):

(1) If a State chooses to issue waivers from the monitoring requirements in §§ 141.23, 141.24, and 141.40, the State

shall describe the procedures and criteria which it will use to review waiver applications and issue waiver determinations.

(i) The procedures for each contaminant or class of contaminants shall include a description of:

(A) The waiver application requirements;

(B) The State review process for "use" waivers and for "susceptibility" waivers; and

(C) The State decision criteria, including the factors that will be considered in deciding to grant or deny waivers. The decision criteria must include the factors specified in §§ 141.24(f)(8), 141.24(h)(8), and 141.40(n)(4).

(ii) The State must specify the monitoring data and other documentation required to demonstrate that the contaminant is eligible for a "use" and/or "susceptibility" waiver.

(2) A plan for the initial monitoring period within which the State will assure that all systems complete the required monitoring by the regulatory deadlines;

(i) The plan must describe how systems will be scheduled during the initial monitoring period and demonstrate that the analytical workload on certified laboratories for each of the three years has been taken into account, to assure that the State's plan will result in a high degree of monitoring compliance and will be updated as necessary.

(ii) The State must demonstrate that the initial plan is enforceable under State law.

5. Section 142.18 is added to subpart B to read as follows:

§ 142.18 EPA review of State monitoring determinations.

(a) A Regional Administrator may annul a State monitoring determination for the types of determinations identified in §§ 141.23(b), 141.23(c), 141.24(f), 141.24(h), and 141.40(n) in accordance with the procedures in paragraph (b) of this section.

(b) When information available to a Regional Administrator, such as the results of an annual review, indicate a State determination fails to apply the standards of the approved State program, he may propose to annul the State monitoring determination by sending the State and the affected PWS a draft Rescission Order. The draft order shall:

(1) Identify the PWS, the State determination, and the provisions at issue;

(2) Explain why the State determination is not in compliance with the State program and must be changed; and

(3) Describe the actions and terms of operation the PWS will be required to implement.

(c) The State and PWS shall have 60 days to comment on the draft Rescission Order.

(d) The Regional Administrator may not issue a Rescission Order to impose conditions less stringent than those imposed by the State.

(e) The Regional Administrator shall also provide an opportunity for comment upon the draft Rescission Order, by

(1) Publishing a notice in a newspaper in general circulation in communities served by the affected system; and

(2) Providing 30 days for public comment on the draft order.

(f) The State shall demonstrate that the determination is reasonable, based on its approved State program.

(g) The Regional Administrator shall decide within 120 days after issuance of the draft Rescission Order to:

(1) Issue the Rescission Order as drafted;

(2) Issue a modified Rescission Order; or

(3) Cancel the Rescission Order.

(h) The Regional Administrator shall set forth the reasons for his decision, including a responsiveness summary addressing significant comments from the State, the PWS and the public.

(i) The Regional Administrator shall send a notice of his final decision to the State, the PWS and all parties who commented upon the draft Rescission Order.

(j) The Rescission Order shall remain in effect until cancelled by the Regional Administrator. The Regional Administrator may cancel a Rescission Order at any time, so long as he notifies those who commented on the draft order.

(k) The Regional Administrator may not delegate the signature authority for a final Rescission Order or the cancellation of an order.

(l) Violation of the actions, or terms of operation, required by a Rescission Order is a violation of the Safe Drinking Water Act.

6. Section 142.57 is revised to read as follows:

§ 142.57 Bottled water, point-of-use, and point-of-entry devices.

(a) A State may require a public water system to use bottled water, point-of-use devices, or point-of-entry devices as a condition of granting an exemption from

the requirements of §§ 141.61 (a) and (c), and § 141.62 of this chapter.

(b) Public water systems using bottled water as a condition of obtaining an exemption from the requirements of §§ 141.61 (a) and (c) and § 141.52(h) of this chapter must meet the requirements in § 142.62(g).

(c) Public water systems that use point-of-use or point-of-entry devices as a condition for receiving an exemption must meet the requirements in § 141.62(h).

7. Section 142.62 is revised to read as follows:

§ 142.62 Variances and exemptions from the maximum contaminant levels for organic and inorganic chemicals.

(a) The Administrator, pursuant to section 1415(a)(1)(A) of the Act hereby identifies the technologies listed in paragraphs (a)(1) through (a)(36) of this section as the best technology, treatment techniques, or other means available for achieving compliance with the maximum contaminant levels for organic chemicals as listed in § 141.61 (a) and (c).

Contaminant	Best available technologies	
	Packed tower section	Granular activated carbon
(1) Benzene.....	X	X
(2) Carbon tetrachloride.....	X	X
(3) 1,2-Dichloroethane.....	X	X
(4) Trichloroethylene.....	X	X
(5) para-Dichlorobenzene.....	X	X
(6) 1,1-Dichloroethylene.....	X	X
(7) 1,1,1-Trichloroethane.....	X	X
(8) Vinyl chloride.....	X	X
(9) cis-1,2-Dichloroethylene.....	X	X
(10) 1,2-Dichloropropane.....	X	X
(11) Ethylbenzene.....	X	X
(12) Monochlorobenzene.....	X	X
(13) o-Dichlorobenzene.....	X	X
(14) Styrene.....	X	X
(15) Tetrachloroethylene.....	X	X
(16) Toluene.....	X	X
(17) trans-1,2-Dichloroethylene.....	X	X
(18) Xylenes (total).....	X	X
(19) Atrichlor.....		X
(20) Aldicarb.....		X
(21) Aldicarb sulfonate.....		X
(22) Aldicarb sulfone.....		X
(23) Atrazine.....		X
(24) Carbofuran.....		X
(25) Chlordane.....		X
(26) Dibromochloropropane.....	X	X
(27) 2,4-D.....		X
(28) Ethylene dibromide.....	X	X
(29) Heptachlor.....		X
(30) Heptachlor epoxide.....		X
(31) Lindane.....		X
(32) Methoxychlor.....		X
(33) PCBs.....		X
(34) Pentachlorophenol.....		X
(35) Toxaphene.....		X
(36) 2,4,5-TP.....		X

(b) The Administrator, pursuant to section 1415(a)(1)(A) of the Act, hereby

identifies the following as the best technology, treatment techniques, or other means available for achieving compliance with the maximum contaminant levels for the inorganic contaminants listed in § 141.62:

BAT FOR INORGANIC COMPOUNDS LISTED IN § 141.62(b)

Chemical name	BAT(a)
Asbestos.....	2,3,8
Barium.....	5,6,7,9
Cadmium.....	2,5,6,7
Chromium.....	2,5,6,7
Mercury.....	2 ¹ , 4, 6 ¹ , 7 ¹
Nitrate.....	5,7,9
Nitrite.....	5,7
Selenium.....	1,2 ¹ , 6,7,9

¹ BAT only if influent Hg concentrations < 10 ug/l

1. BAT for Chromium III only
 2. BAT for Selenium IV only
 Key to BATs in Table
 1 = Activated Alumina
 2 = Coagulation/Filtration (not BAT for systems < 500 service connections)
 3 = Direct and Diatomite Filtration
 4 = Granular Activated Carbon
 5 = Ion Exchange
 6 = Lime Softening (not BAT for systems < 500 service connections)
 7 = Reverse Osmosis
 8 = Corrosion Control
 9 = Electrodialysis

(c) A State shall require community water systems and non-transient, non-community water systems to install and/or use any treatment method identified in § 142.62 (a) and (b) as a condition for granting a variance except as provided in paragraph (d) of this section. If, after the system's installation of the treatment method, the system cannot meet the MCL, that system shall be eligible for a variance under the provisions of section 1415(a)(1)(A) of the Act.

(d) If a system can demonstrate through comprehensive engineering assessments, which may include pilot plant studies, that the treatment methods identified in § 142.62 (a) and (b) would only achieve a *de minimis* reduction in contaminants, the State may issue a schedule of compliance that requires the system being granted the variance to examine other treatment methods as a condition of obtaining the variance.

(e) If the State determines that a treatment method identified in paragraph (d) of this section is technically feasible, the Administrator or primary State may require the system to install and/or use that treatment method in connection with a compliance schedule issued under the provisions of section 1415(a)(1)(A) of the Act. The State's determination shall be based upon studies by the system and other relevant information.

(f) The State may require a public water system to use bottled water, point-of-use devices, point-of-entry devices or other means as a condition of granting a variance or an exemption from the requirements of § 141.61 (a) and (c) and § 141.62 to avoid an unreasonable risk to health.

(g) Public water systems that use bottled water as a condition for receiving a variance or an exemption from the requirements of § 141.61 (a) and (c) and § 141.62 must meet the requirements specified in either paragraph (g)(1) or (g)(2) and paragraph (g)(3) of this section:

(1) The Administrator or primary State must require and approve a monitoring program for bottled water. The public water system must develop and put in place a monitoring program that provides reasonable assurances that the bottled water meets all MCLs. The public water system must monitor a representative sample of the bottled water for all contaminants regulated under § 141.61 (a) and (c) and § 141.62 during the first three-month period that it supplies the bottled water to the public, and annually thereafter. Results of the monitoring program shall be provided to the State annually.

(2) The public water system must receive a certification from the bottled water company that the bottled water supplied has been taken from an "approved source" as defined in 21 CFR 129.3(a); the bottled water company has conducted monitoring in accordance with 21 CFR 129.80(g) (1) through (3); and the bottled water does not exceed any MCLs or quality limits as set out in 21 CFR 103.35, 110, and 129. The public water system shall provide the certification to the State the first quarter after it supplies bottled water and annually thereafter. At the State's option a public water system may satisfy the requirements of this subsection if an approved monitoring program is already in place in another State.

(3) The public water system is fully responsible for the provision of sufficient quantities of bottled water to every person supplied by the public water system via door-to-door bottled water delivery.

(h) Public water systems that use point-of-use or point-of-entry devices as a condition for obtaining a variance or an exemption from NPDWRs must meet the following requirements:

(1) It is the responsibility of the public water system to operate and maintain the point-of-use and/or point-of-entry treatment system.

(2) Before point-of-use or point-of-entry devices are installed, the public water system must obtain the approval

of a monitoring plan which ensures that the devices provide health protection equivalent to that provided by central water treatment.

(3) The public water system must apply effective technology under a State-approved plan. The microbiological safety of the water must be maintained at all times.

(4) The State must require adequate certification of performance, field testing, and, if not included in the certification process, a rigorous engineering design review of the point-of-use and/or point-of-entry devices.

(5) The design and application of the point-of-use and/or point-of-entry devices must consider the potential for increasing concentrations of heterotrophic bacteria in water treated with activated carbon. It may be necessary to use frequent backwashing, post-contact disinfection, and Heterotrophic Plate Count monitoring to ensure that the microbiological safety of the water is not compromised.

(6) The State must be assured that buildings connected to the system have sufficient point-of-use or point-of-entry devices that are properly installed, maintained, and monitored such that all consumers will be protected.

PART 143—NATIONAL SECONDARY DRINKING WATER REGULATIONS

1. The authority citation for part 143 continues to read as follows:

Authority: 42 U.S.C. 300g-1(c), 300j-4, and 300j-9.

2. In § 143.3 the table is revised to read as follows:

§ 143.3 Secondary maximum contaminant levels.

Contaminant	Level
Aluminum	0.05 to 0.2 mg/l.
Chloride	250 mg/l.
Color	15 color units.
Copper	1.0 mg/l.
Corrosivity	Non-corrosive.
Fluoride	2.0 mg/l.
Foaming agents	0.5 mg/l.
Iron	0.3 mg/l.
Manganese	0.05 mg/l.
Odor	3 threshold odor number.
pH	6.5-8.5.
Silver	0.1 mg/l.
Sulfate	250 mg/l.
Total dissolved solids (TDS)	500 mg/l.
Zinc	5 mg/l.

3. Section 143.4 is amended by adding paragraphs (b)(12) and (b)(13) to read as follows:

§ 143.4 Monitoring.

(b) . . .

(12) Aluminum—Method ¹ 202.1 Atomic Absorption Technique-Direct, Aspiration; or Method ² 303C; or Method ³ I-305i-84; or Method ¹ 202.2 Atomic Absorption-Graphite Furnace Technique; or Method ² 304; or Method ¹ 200.7 Inductively-Coupled Plasma Technique; or Method ⁶ 200.8 Inductively Coupled Plasma-Mass Spectrometry or Method ⁶ 200.9 Platform Technique; or Method ⁷ 3120B Inductively-Coupled Plasma Technique.

(13) Silver—Method ¹ 272.1 Atomic Absorption Technique-Direct Aspiration; or Method ² 303 A or B; or Method ³ I-3720-84; or Method ¹ 272.2 Atomic Absorption-Graphite Furnace Technique; or Method ² 304; or Method ¹ 200.7 Inductively-Coupled Plasma-Technique; or Method ⁶ 200.8 Inductively-Coupled Plasma-Mass Spectrometry; or Method ⁶ 200.9 Platform Technique; or Method ⁷ 3120B Inductively-Coupled Plasma-Technique.

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¹ "Methods of Chemical Analysis of Water and Wastes," EPA, Environmental Monitoring and Systems Laboratory, Cincinnati, OH 45268, EPA 600/4-79-020, March, 1983. Available from ORD Publication, CERL, EPA, Cincinnati, OH 45268.

² "Standard Methods for the Examination of Water and Wastewater," 18th Ed., American Public Health Association, American Waterworks Association, Water Pollution Control Federation, 1985.

³ "Methods for the Determination of Inorganic Substances in Water and Fluvial Sediments," Techniques of Water-Resources Investigations of the United States Geological Survey Books, Chapter A1, 1985. Available from Open File Services Section, Western Distribution Branch, U.S. Geological Survey, Denver Federal Center, Denver, CO 80255.

⁴ "Determination of Metals and Trace Elements by Inductively Coupled Plasma-Atomic Emission Spectrometry," Method 200.7, version 3.1, April, 1990, EPA, Environmental Monitoring and Systems Laboratory, Cincinnati, OH 45268.

⁵ "Determination of and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry," Method 200.8, version 4.1, March, 1990, EPA, Environmental Monitoring and Systems Laboratory, Cincinnati, OH 45268. Available from ORD Publication, CERL, EPA, Cincinnati, OH 45268.

⁶ "Determination of Metals and Trace Elements by Stabilized Temperature Graphite Furnace Atomic Absorption Spectrometry," Method 200.9, version 1.0, April, 1990, EPA, Environmental Monitoring and Systems Laboratory, Cincinnati, OH 45268.

⁷ "Standard Methods for the Examination of Water and Wastewater," 18th ed., American Public Health Association, American Waterworks Association, Water Pollution Control Federation, 1985.

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